Farmers and Water Quality

Local Answers to Local Issues

BASELINE REPORT

Evaluation of Producer Involvement in the United States Department of Agriculture 1990 Water Quality Demonstration Projects

Submitted to U.S. Department of Agriculture

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ABSTRACT

This report presents the rationale, approach, and preliminary findings of a five-year evaluation of the extent to which the FY 1990 USDA Water Quality Demonstration Projects accelerate voluntary adoption of best management practices by agricultural producers. The eight projects being evaluated address a variety of agricultural nonpoint source pollutants affecting the Nation's waters, and use a variety of informational and promotional mechanisms to reach state cooperators to promote optimal management and land treatment practices that protect or improve water quality. This study measures changes in the adoption of these practices across time, accounts for demonstration and communication influences on decision processes, and interprets the findings to enhance future USDA water quality efforts.

I. INTRODUCTION

A. The USDA Water Quality Plan

In responding to the President's 1989 Water Quality Initiative, the United States Department of Agriculture developed a number of special programs to help protect or improve the Nation's water quality (i.e., the USDA Water Quality Program Plan to Support the President's Water Quality Initiative). The Extension Service (ES), Soil Conservation Service (SCS), and Agricultural Stabilization and Conservation Service (ASCS) support the USDA Water Quality Plan through education, technical and financial assistance. These efforts are implemented through USDA-sponsored Water Quality Demonstration Projects, Nonpoint Source Hydrologic Unit Areas, Regional Project Initiatives, and Agricultural Water Quality Program Water Quality Special Projects.

Of relevance to this report are the USDA Water Quality Demonstration Projects, which have the goal of accelerating voluntary adoption of agricultural practices that are agronomically sound and economically profitable, yet still protect and/or enhance water quality. The 1990 Farm Bill (Sec. 1238A) referred to these as agricultural water quality protection practices. This term was defined in the legislation as meaning "a farm-level practice or a system of practices designed to protect water quality by mitigating or reducing the release of agricultural pollutants, including nutrients, pesticides, animal waste, sediment, salts, biological contaminants, and other materials, into the environment." Practices that meet these criteria have traditionally been called Best Management Practices (BMPs).

A critical component of USDA activities in the area of agricultural water quality is evaluation. The USDA has made a commitment from the beginning to provide an objective assessment of the effectiveness of program efforts. An overall strategy to evaluate water quality education and technical assistance activities involves most USDA agencies, as well as the Environmental Protection Agency and the United States Geologic Survey. The evaluation will be conducted relative to all components of the USDA Water Quality Plan.

Evaluation Mandate

The USDA Water Quality Program Plan requires an evaluation of the performance of this FY 1990-94 Program. To implement the Program Plan, the Educational, Technical, and Financial Assistance Committee (ET&FA) of the USDA Working Group on Water Quality developed the conceptual evaluation framework. Three USDA agencies -- Economic Research Service (ERS), Extension Service, and Soil Conservation Service -- are responsible for evaluating the ET&FA program from a national perspective. This evaluation has four major components: I - Initial Organization and Implementation; II - Producer adoption; III - Physical Impact Assessment; and IV - Economic Assessment.

I Organization and Initial Implementation. ES took leadership in the first component: Assessment of the organization and Initial Implementation of the Eight Demonstration Projects Approved in FY 1990. Kay Rockwell and DeLynn Hay, Cooperative Extension, University of Nebraska, acted as co-principal investigators. The Nebraska team visited each project to assess project plans, coordination and cooperation among local-state-federal agencies, and early implementation. Agency staff were the main data source. The final report was published in January 1992.

II Producer Adoption. ES is taking leadership in the second component: Evaluation of Producer Adoption of Water Quality Measures in the first eight demonstration projects. Peter Nowak, Department of Rural Sociology, and Garrett O'Keefe, Department of Agricultural Journalism, University of Wisconsin, are the principal investigators. Producers in 15 areas (each of the eight projects and seven comparison areas) are being surveyed in 1992, 1993, 1994 and 1995 by mail questionnaires. The purpose is to: a) make a statistically valid estimate of the acceleration of adoption of measures to protect or improve water quality; and b) determine the influence of the demonstration and other factors on rates of adoption.

III Physical Impact Assessment. SCS is taking leadership in the third component: Physical Impact Assessment (Assessment). The purpose is to assess the impact of practices implemented by the first eight Demonstration Projects and eight selected Hydrologic

Unit Areas on protecting or improving water quality due to agricultural nonpoint source pollution, and to document those effects. Members of the assessment team are: Ray H. Griggs, Agricultural Engineer, Blackland Research Center, Texas A & M University; Donald W. Meals, Research Associate, School of Natural Resources, University of Vermont; and John D. Sutton, Agricultural Economist, SCS, Strategic Planning and Policy Analysis Staff, Washington, D.C. Assessment data will be provided to ERS for Component IV.

IV Economic Cost-Effectiveness and Benefits. ERS is taking leadership in the forth component: Economic Cost-Effectiveness and Benefits. The purpose is to measure economic net benefits of reasonable water quality activities. The projects to be studied will be among the 16 participating in the Physical Impact Assessment.

This report presents the approach taken and preliminary findings from evaluation Component II - Producer Adoption. The report gives an overview of the projects under study, the producer adoption evaluation approach, producer views on water quality and the selected BMPs, extent of use of selected BMPs in 1991/92 and related factors, and provisional recommendations to improve water quality programming by the USDA and State Cooperators.

B. The FY 1990 Demonstration Projects

Producer adoption is being evaluated in the eight USDA Water Quality Plan Demonstration Projects approved in FY 1990. These are sited in California, Florida, Maryland, Minnesota, Nebraska, North Carolina, Texas, and Wisconsin. All are in watershed areas with documented instances of water quality problems related to agriculture. Each watershed has a unique mix of producer types and specific water quality risks. Experts at each site have identified BMPs capable of reducing agricultural contaminants.

The primary objectives of these projects are to: (1) accelerate voluntary producer adoption of BMPs that protect surface and ground waters from agricultural activities, and (2) show how quickly and effectively producers can modify their current agricultural practices to achieve the first objective. Producers are being encouraged to voluntarily adopt BMPs compatible with both at-site water contamination risks and their own production situations. Each project uses a demonstration project approach involving communication campaign techniques to convey appropriate BMP information.

One of the key differences between this program and many other federal and state efforts aimed at reducing water pollution from non-point agricultural resources is the extensive use of **demonstration farms** (or on-farm demonstrations) as a central

component of Extension/SCS communication strategies or campaigns. The USDA expects that the demonstration of practical water quality BMPs on representative working farms in the target areas could be an effective mechanism for encouraging changes in farmers' behavior.

1. California: Rice Water Quality Demonstration Project

The Sacramento Valley contains 90% of California's rice lands, which drain into the Sacramento River system. For this reason, the California Demonstration Project was the one location where a suitable comparison site could not be located. In the demonstration area, one-half of the total rice land is on poorly drained clay soil that becomes waterlogged and anaerobic with winter rainfall or summer irrigation. The predominant rice irrigation method in California is by continuous flood of sowing in the spring and for approximately 120 days until the fields are drained for harvest.

Pesticide detects in the groundwater and fish kills indicate movement off-site. A bitter taste in the municipal drinking water of the city of Sacramento was attributed to a rice herbicide metabolite in 1981.

Demonstration Objectives

- To provide an information base of various types of water management systems currently used in rice production.
- To prepare a state-of-the art rice water management publication emphasizing strategies for converting to self-contained irrigation systems.
- To establish and evaluate prototype static water or tail water return systems for use in demonstration and education of economical and effective irrigation of rice.
- To identify the characteristics of soils leading to groundwater pollution in California rice soils, to provide mapping of their locations and recommendations to ameliorate chemical movement into groundwater.
- To provide research sites within the demonstration project to further evaluate factors related to rice pesticides, water management, environmental changes, cropping system changes, and related issues.

2. Florida: Lake Manatee Watershed Project

The Lake Manatee Watershed encompasses approximately 81,000 acres along Florida's west central Gulf Coast. The Manatee Lake Reservoir serves as the municipal water source for the city of Bradenton and several smaller communities total 275,000 residents. There is increasing urban pressures to protect the quality of this water source.

The upper reaches of the watershed are situated in the state's phosphate mining region. As a result the lake has been identified as nitrate, rather than phosphate, limited with respect to its increasingly common blooms of blue-green algae.

Demonstration Objectives

- To assess loadings of nitrogen and phosphorus to Lake Manatee and the order-of magnitude pesticide levels. (possibly in sub-watershed basis)
- To assist growers in adopting water and fertilizer management technologies that will reduce the amount of fertilizer nutrients (emphasis on nitrogen).
- To assist growers in utilizing state-of-the art, often computer-based on-farm decision making packages to bast manage their fertilizer and pesticide inputs for minimization of groundwater and lake water contamination.
- To survey producers in the watershed to ascertain base-level fertilizer and pest-control practices, from which to gauge Best management Practice adoption. To survey producers following project completion to establish the degree of adoption and success of various management practices designed to reduce groundwater contamination risks.

3. Maryland: Monocacy River Watershed Project

The Monocacy River watershed is a sub-basin of the middle Potomac River Basin located in Frederick, Carroll and Montgomery counties. Groundwater resources in the Monocacy river watershed are and have the potential to be impacted by nitrogen and agrichemicals due to the nature or agricultural activities and the geology of the area.

Nonpoint sources of pollution tend to be the major contributors of nutrients, bacteria and suspended sediments to ground and surface waters. The predominant sources of nutrients

are agricultural operations and animal wastes.

Demonstration Objectives

- To develop and implement effective nutrient management plans.
- To demonstrate the use of cover crops for nutrient management.
- To plan and apply erosion and sediment control systems.
- To implement an Integrated Pest Management (IPM) program.
- To demonstrate safe handling of agrichemicals including adoption of proper storage, mixing, application, clean-up and disposal.
- To establish cost-sharing and incentive payment program for those who cannot afford nutrient and pest management systems.
- To demonstration the need for wellhead protection which includes: information on the maintenance of wells, on-site waste water disposal stems and the health effects of contaminated water.
- Develop an interagency team for contacting and working with farmers to coordinate effort so farmers are not "pestered to death".

4. Minnesota: Anoka Sand Plain Demonstration Project

The Anoka Sand Plain extends through eleven counties of east central and central Minnesota and consists of sandy soils typically low in organic matter and clay content over shallow, surficial aquifers. The intensity of livestock production is relatively low. Crop production is the firm base for both irrigated and dry land agriculture. The major crops are field corn, soybeans, potatoes and sweet corn.

In recent years there has been a rapid expansion of residential development into the Sand Plains. This development magnifies the concerns that revolve around the quality of the groundwater. In addition the Anoka Sand Plain is a groundwater recharge area as well as a source of recharge for the Mississippi River which supplies water for the Twin Cities.

The Anoka Sand Plain is experiencing high levels of nitrate-nitrogen in the groundwater. Thirty of 99 wells sampled have

been found to have concentrations in excess of 10 ppm.

Demonstration Objectives

- To assist growers in adopting nitrogen management practices that will reduce the amount of fertilizer nitrogen used in crop production.
- To increase farmer use of more efficient irrigation management practices.
- To develop and test an integrated Best Management Practice approach to select pest control practices, both point and non-point source issues will be addressed.
- To gain on-farm adoption and experience with current state of the art Best Management Practices to protect water quality.
- Adoption by cooperators of best management practices for handling and application of pesticides to prevent point source groundwater contamination including: pesticide transportation, storage, mixing, loading, responding to spills, prevention of back-siphoning, equipment maintenance, calibration and cleaning, application techniques, off site movement and pesticide waste and container storage and disposal.

5. Nebraska: Mid-Nebraska Demonstration Project

Certain areas of the central Platte Valley have high concentration of nitrate in groundwater due to the use of high rates of nitrogen fertilizer and excessive irrigation water for corn. Generally, groundwater which is most effected by elevated nitrate concentration is shallow and underlies coarse-textured alluvial soils which are primarily under irrigated corn cultivation.

Groundwater underneath the finer textured upland soils has show trends of increasing nitrate levels in some parts of Nebraska. Recent surveys of irrigation domestic and municipal wells in Nebraska show an increasing number of wells testing greater than 10ppm in nitrates.

With continued deep percolation of excess irrigation water, movement of nitrate presently in the intermediate vadose zone into the aquifer can be expected, with a corresponding increase in groundwater nitrate concentration.

Demonstration Objectives

- To foster adoption of nutrient and pesticide management practices that reduce chemical loading.
- To promote producer adoption of irrigation management practices that provide adequate moisture to growing crops while impeding leaching of agrichemicals to groundwater.
- To demonstrate that producers can achieve suitable economic returns while utilizing agricultural chemical and irrigation management practices.
- To encourage adoption of agrichemical and irrigation management practices that will ensure the preservation of groundwater quality.
- To demonstrate management of nutrient resources using animal waste and commercial fertilizer.
- To conduct a pre-implementation/post-implementation assessment.

6. North Carolina: Herrings Marsh Run Watershed Project

Herrings Marsh Run is located in northwestern Duplin County. This area contains medium to coarse textured soils that have seasonally high water tables. A high potential exists for impacting surface and groundwater as well as adjoining estuarine and environmentally sensitive recreational waters.

Duplin County has the highest agricultural revenue of any county in North Carolina ($268 million). Approximately 77% comes from the poultry and swine industry.

The overall project goal is to protect the water quality in the total Cape Fear Basin of which Herrings Marsh Run is a part.

Demonstration Objectives

- To demonstrate accelerated voluntary adoption of crop and animal production practices that reduce impacts on surface and groundwater by increased technical and educational assistance.
- Commercial fertilizer purchases are to be reduced by 30% because of more efficient animal waste recycling to cropland.

- Centralized dead animal disposal sites to handle turkeys and hogs.
- Well testing for nitrates, chlorides and conductivity to determine potential pollution from over-fertilization, improper animal waste management or poorly functioning septic tanks.
- Protection of drinking water through waste water management.
- To reduce pesticide loading to surface waters.
- To reduce swine production inputs to surface waters.
- To reduce poultry production inputs to surface waters.
- Increase participation in the Integrated Pest management Program.

7. Texas: Seco Creek Watershed Project

The Seco Creek Watershed comprises an area of 267 square miles in Bandera, Frio, Medina and Uvalde Counties in South Central Texas (50 miles west-northwest of San Antonio). In many places, streams of surface water enter the aquifer directly through open caves. Seco Creek is a source of recharge to the Edwards Aquifer (supplies water for 2 million people) and is similar to other streams that cross the recharge zone. There is no filtration or purification effect of water moving through the soil material.

The Seco Creek Watershed is comprised predominantly of rangeland. The water quality problems in Seco Creek relate to sediment and associated nutrients and pesticides. Efforts to increase flow (runoff) may potentially cause elevated sediment or nutrient content in recharge water.

Demonstration Objectives

- To reduce the impacts of nonpoint source water pollution from agricultural chemicals, animal wastes and sediment.
- To effectively suppress erosion and reduce sedimentation.
- To demonstrate the potential economic, social, and environmental impacts of various resource management systems.
- To demonstrate the agricultural community's willingness to address problems of water quality.

- Integrated brush and grazing management systems, that are necessary for water quality management, wildlife habitat improvement, and erosion control on sustainable agricultural production units.

- Use of cropland management systems to improve water use efficiency (i.e, irrigation).

- Soil testing to determine recommendations for proper nutrient application rates, types of fertilizers, methods of application, fertilizer timing and splitting of applications.

- Integrated Pest Management which includes: alternative application methods, rates, placement, and timing and proper disposal of waste chemicals and containers.

- Utilization of crops and crop rotations to reduce both agricultural chemical use and effect of pests.

- Use of climatological data to manage crops.

- Tradeoffs between surface runoff and infiltration rates and water quality and water quantity that enters both surface and ground water systems as a result of alternative land management practices.

- Improvement in water well design or closure.

- Proper handling and disposal of rural household sewage, solid waste including chemicals and containers, and animal wastes including runoff.

8. Wisconsin: Water Quality Demonstration Project: East River

Ground and surface water problems have been identified within the East River Watershed, a 215 square mile, rural-urban area, located in two counties of northeastern Wisconsin, just south of Green Bay. Nutrients, pesticides and other toxic materials from agriculture contribute to this contamination.

Karst features are present in the watershed. Many municipal wells utilize the aquifers (draw-down in DePere is 250, encompassing all of Brown County).

Approximately 24% of the northeast portion of the watershed lies within metropolitan Green Bay. The most intensively farmed area of the county lies within the watershed. Sixty percent of the watershed is cropland. Four hundred of the watershed's 550

farms are dairy operations totaling nearly 42,000 animal units.

Recent findings indicate that inadequate crediting or lack of crediting livestock waste for nutrients has caused excessively high nitrogen and/or phosphorus levels on cropland. Reducing phosphorus loads to Green Bay through increased use of BMPs for nonpoint source pollution control may reduce the need for 150 million dollar improvements to the Green Bay Metropolitan Sewage Plant.

Demonstration Objectives

- To reduce nutrient and pesticide pollution of groundwater and surface water through improved cropland, pasture, streambank and wetland management.
- To reduce pollution potential from ag chemicals, livestock waste, human sewage and hazardous waste through improved design of farmstead structures.
- Increasing landowners knowledge of drinking water quality.

C. Key Aspects of the Evaluation

The purpose of the evaluation effort is to conduct an investigation of the eight 1990 water quality demonstration projects in terms of their effectiveness of accelerating producer adoption of recommended BMPs. The study will measure the rates at which targeted audiences move through the process of adopting selected BMPs. The rate of adoption will be an indication of the social and economic acceptability of these practices as well as the communication effectiveness of the demonstration projects. The theoretical rationale underlying this approach appears in Appendix A.

Thus, the overall objectives of the producer adoption study are (1) to measure adoption across time by specified target audiences, (2) account for practice demonstrations and other communication influences on this decision process, and (3) interpret the findings in such a way that future technology transfer efforts will be enhanced. A full description of the methodology utilized appears in Appendix B, followed by designs for subsequent phases of the project in Appendix C.

1. Research Design

The producer adoption study is based on a quasi-experimental research design using both demonstration and comparison areas.

Comparison areas were determined to be necessary to the research design in order to more accurately measure the influence of the demonstration projects on accelerating voluntary adoption of BMPs. Therefore, comparison areas were identified by local project staff after matching on physical and farm enterprise features. Large representative samples of producers in each demonstration and comparison area are being surveyed at four points in time. Participating landusers have been selected using spatial sampling techniques to avoid any biases associated with existing lists. Approximately 50% of the sampled producers were surveyed in 1992, another 20% (plus subsamples of the original 50%) will be surveyed on selected issues in 1993 and in 1994, and the remaining 10% plus all previous respondents will be contacted in 1995 (See Figure 1).

The evaluation is guided by a melding of technology adoption and agricultural communication models to address: (1) initial farmer awareness, knowledge, receptivity and behavior relative to the BMPs being demonstrated; (2) responses to the demonstration and other communication efforts, as well as farmer assessments of the proposed practices; and (3) the impact of demonstration efforts on knowledge levels and extent of adoption of demonstrated practices.

Consequently, the evaluation focuses on two major issues: first, to measure the effectiveness of a demonstration as a dissemination mechanism for communicating essential attributes of selected BMPs; and second, to measure the rates at which target audiences move through the adoption process as an indicator of BMP social and economic acceptability and communication effectiveness.

2. Factors Measured

A number of specific factors are being measured at one or more points in time in order to accomplish the above objectives. These can be organized into BMP characteristics, individual characteristics, assistance networks, farm characteristics, demonstration features and other factors.

BMP Characteristics

Given the extremely large and varied number of BMPs that could potentially be promoted at each of the demonstration sites, we were forced to develop a strategy for carefully selecting a sampling of BMPs that would: (a) allow national comparisons of BMP characteristics across sites; (b) be actively promoted and relevant at the local level; and (c) allow determination of key components of BMPs that would help explain patterns of adoption. The selection strategy included focusing on four dimensions of BMPs: capital, labor and managerial requirements, and potential

for divisibility. The more than 100 practices identified across the eight sites were rated by USDA line agency personnel, state coordinators, and the UW Technical Review Group. Several iterations of cluster analyses and other techniques resulted in the grouping of BMPs in Figure 2. Thus, the initial number of BMPs was reduced to those included in the current study.

Individual Characteristics

Of primary concern are the individual farmers and ranchers who are expected to adopt recommended BMPs. Measures were obtained of changes in following variables:

a. The **level of awareness** of specific, relevant BMPs. Respondents were offered comprehensive definitions or descriptions of BMPs and asked if they were aware that these practices were available in their local area.

b. Changes in the **level of knowledge** about these BMPs. Accurate and complete knowledge is necessary for a valid evaluation of a BMP. Respondents were asked to assess the accuracy of a series of statements about selected BMPs. Results will indicate knowledge levels on these BMPs.

c. How this knowledge (after controlling for completeness and accuracy) is employed in **evaluating specific BMPs** was also assessed. That is, respondents were asked to evaluate each BMP along agronomic, economic, and social dimensions. Also measured were pre-existing perceptions and cognitions about the capability of these BMPs to significantly affect water quality.

d. Other more **standard individual measures** were also obtained of such factors as age, formal education, years farming experience, influence of landlords and future plans, etc.

Assistance Network Linkages

The evaluation also took into account producers' linkages and orientations toward communication sources.

a. Farmers' and ranchers' use of various **sources of information, education and assistance** regarding water quality-related practices. Specific measures were made of: (1) producers' frequency of use of such sources; (2) the perceived agronomic and economic utility of the sources; (3) their credibility; and (4) their perceived influence on actual practices.

b. A similar assessment was made of the **communication**

activities associated with the demonstration project. Investigation of these communication-related factors was needed to determine: (1) how pre-existing orientations to communication programs are related to exposure and impact of the demonstration programs; (2) whether such pre-existing orientations may in and of themselves contribute to changes in adoption over the study period; and (3) how they may interact with demonstration activities to affect adoption rates.

Farm Characteristics

A number of farm or ranch characteristics have also been measured. Additional information on the farm or ranch operation will be obtained in later phases of the evaluation project.

a. Farm **economic features** such as dependence on specific commodities or farm enterprise mix, past fluctuations in the prices of those commodities, changes in the price of applicable farm inputs, farm and nonfarm income, and cash flow status.

b. The **proximity (distance, travel time) to the demonstration project sites** were measured in the demonstration areas.

c. **Scale of operations** (size) and certain labor characteristics were also measured.

d. The **tenure** of the land operated within the farm organization was also measured under various tenure arrangements.

e. The specific **application levels of agrichemicals** associated with the selected BMPs. This focused, where applicable, on nitrogen, herbicides and insecticides.

f. The primary dependent variable in the project will be measurement of **change in extent of adoption of specified BMPs** across the eight projects. Consequently, for those farms where recommended practices are used, a measure of the extent of use was obtained.

Demonstration and Information Campaign Characteristics

Information was collected on the nature and type of each demonstration project and their related information and education efforts. (In the comparison sites this measurement focused on other communication and assistance efforts.) Much of the data was collected from secondary sources, i.e., not from farmers or

ranchers but from project personnel and other local information sources.

a. In the demonstration areas this data collection effort focused on the **type, extent, and intensity of communication efforts** surrounding the water quality project.

b. Respondents were also asked to **evaluate various information transfer techniques** (e.g., field days, demonstrations, fact sheets, video, small group meetings, on-farm visits, etc.) in order to develop a template of accepted strategies or techniques to improve technology transfer by USDA and cooperating agencies.

c. Each demonstration effort was **evaluated according to a public communication campaign framework.** This latter effort has depended on secondary materials, plans of work, and observations by farmers or ranchers. This included evaluating each demonstration site according to: (1) specification of discrete objectives; (2) segmentation of target audiences; (3) sequence of planned activities within a specified time period; and (4) adaptation of communication activities as diffusion occurs within the demonstration area.

d. The baseline data necessary to quantify the **change in the extent of adoption of specified BMPs across the project area** were also obtained. This measure will be compared to the comparison area to quantify the extent of accelerated adoption in the demonstration area.

e. The **characteristics of any other water quality efforts or programs occurring in demonstration and comparison areas.** This included documentation of the programs or efforts; assessments by local staff charged with implementing this program; and questions (included in respondent questionaires) relating to assessment of the program under evaluation.

Allied Factors

Other variables measured in the baseline included a range of economic, cultural, social and environmental factors that have been suggested to impinge on producer involvement in the projects.

D. Field Work

Data were gathered by mail questionnaires administered according to Dillman's (1978, 1991) recommended techniques to achieve

enhanced quality and quantity of survey responses. Field work was carried out from December 1991 through late spring 1992, with state-by-state dissemination scheduled according to planting seasons and related factors. Total overall response rate was 70%. Analyses of respondent return trends and data gathered in personal interviews with nonrespondent groups suggest no pattern of significant differences between those who participated in the study and those who did not. While there was a tendency for more respondents to report having had an instance of a water pollution problem on their own land, no indications were found that they regarded these problems as more serious than nonrespondents, or that they differed in awareness, evaluation, of use of BMPs.

E. Analysis Plan

Analyses will focus upon determining the extent to which program efforts contribute to the accelerated adoption of water quality BMPs beyond that which would have occurred in the absence of any similar program. The rates at which the target audiences move through the adoption process reflects the effectiveness of the communication program and provides an indication of the social and economic acceptability of particular practices. Graphically, this basic research hypothesis is represented in Figure 4.1 below. A second analytic objective is to measure the relative effectiveness of on-farm demonstrations as dissemination mechanisms for communicating the salient attributes of selected water quality BMPs to producers.

II. COMMUNICATION AND DEMONSTRATION EFFORTS

A necessary starting point for evaluating the impact of the eight state projects is to provide a context by describing their organizational structure, dynamics of interagency cooperation and communication, and information and education (I & E) components and strategies.

The projects' I & E strategies are being tracked through site visits, long-distance telephone interviews, questionnaires and document collection detailed in Appendix B.

A. Preliminary Findings

The I & E components supporting the demonstrations appear to be loosely structured in most of the states under evaluation. Information about demonstrations, tours and field days appears to be disseminated mostly on an ad hoc basis, as events are planned. Controlled media and public meetings appear to be the most heavily used outlets for informing producers about BMPs, and public media appear to be used primarily for purposes of informing producers about demonstration tours and field days (via

press releases), but not always actively to prime the public about how the projects are addressing water quality problems and enlisting producer participation to resolve them.

Extent of farmer awareness and concern for water quality problems is a gray area. Many project planners and communication practitioners perceive their farm populations as fairly concerned and aware; however, there are no substantial data in most of these states to either confirm or disconfirm this perception. A farmer's perception of the proximity of the problem may be crucial when it comes to paying attention to BMP information and making adoption decisions. Furthermore, in terms of message development, it appears that the thrust of communication efforts has been more frequently on the practical aspects of the BMPs rather than on building problem awareness and selling the concept of protecting water quality. Building problem awareness is an important first step in promoting a practice. If water quality is a problem of low priority (or not proximate) in a farmer's mind, it may remain a low priority until the significance of the problem "hits home." For these reasons, communication specialists and project managers may need to get a more accurate reading of awareness levels of their producer audiences. Having more accurate information about their audiences may help project planners more effectively structure and pace communication efforts.

Other factors that may influence adoption include cost-share amounts/availability and producer perceptions of government. Some project planners believe the availability of cost-share dollars is a primary motivator in BMP adoption, especially the more expensive BMPs. However, some project planners have also pointed out that the red tape of applying for cost-share dollars may be prohibitive to farmers when the practices require less financial investment. Some farmers would rather not work with the government if they can avoid it, and would consider the added personal expense worth the cost.

This brings up another factor that may influence how willing farmers are to adopt BMPs -- their perception of the message sender: the government. Some project staff have characterized producer perceptions of the government as either luke-warm or negative, depending upon their experience. It is unclear whether or not message senders have taken this opinion of government programs into account when they formulate messages to inform publics of the BMPs being promoted by their projects.

At least some farmers may well be "negatively inspired" to become involved in the water quality projects. Problem awareness, or the idea that there is a need to protect water quality, may be partially inspired by environmental groups (or the media) pointing fingers at agriculture as a problem source, and legislators/regulators putting greater pressure on farmers

through accelerating legislative/regulatory activity. Farmers are concerned about their public image and want to avoid regulation. At times this may be what motivates them to walk through the doors of government offices looking for cost-effective, viable options. Therefore, farmers occasionally may be inspired to investigate and adopt BMPs because they are feeling cornered by the "opposition."

On the more positive side, farmers may become motivated to adopt BMPs because they see one of their own waving the "Let's Protect Water Quality" banner. One of the best things a project may be able to do to build its own image is to enlist cooperators who have strong public images, are well-respected and get high yields off their land. One project leader enlisted a cooperator who was well-known for getting the highest yields in his county (perhaps the state). People want to know how he does it. By enlisting the cooperation of such producers, a project strengthens its stance in the community.

B. Project Planning and Effectiveness

A number of factors were determined to contribute to effective planning and management of the demonstration projects and communication campaigns. These include:

- Qualified communications personnel contributing expertise to project planning efforts;
- Pro-active planning with clear objectives;
- Strong interagency communication where roles and responsibilities are clearly defined and follow-through is consistently high;
- Enlisting community leaders and respected cooperators to participate in demonstration activities; and
- Utilization of public media to build problem awareness.

Some of the projects are strong in the majority of these areas. It is important, however, to avoid ranking these projects against one another in terms of a questionable "success" criterion, because all the states vary in terms of the professional and personnel resources available to them. Most of them are doing what they can with the resources they have available, and are doing so in the face of budget cuts. Other factors enter in, as well. For example, for various reasons, some states were able to mobilize project teams fairly quickly after project award and thus move their projects more quickly into the field; also, some states were able to piggy-back the demonstration project on top of other projects in progress or

completed.

In addition, projects that have some weaknesses in terms of personnel availability and organization may have the greatest struggle in harnessing resources for both their I & E and demonstration efforts. These projects need to be evaluated in their reasonable context, given the logistical and personnel constraints that may have influenced their development.

Finally, it is also important to point out that the priority placed on developing creative and well-planned I & E campaigns (in support of demonstration efforts) at the state and local level may be a direct reflection of how much priority has been placed on the I & E area at the Federal level -- at the USDA. The USDA appears to have placed significant emphasis on data collection and monitoring of water quality levels, but less emphasis on audience research, which looks at composition of producer audiences and problem awareness levels, or on the potential positive impact of education efforts which may reap long-term benefits after the projects are terminated in 1995. (The data gleaned from this study should provide some of this kind of information to the states as the results become available; however, having such information prior to project inception and I & E plan development would definitely have been a plus.) Given the USDA priorities communicated to the states via reporting requirements, it seems only natural that personnel and financial resources may be more likely to be funneled into technical areas.

C. Long-Range Considerations

Although the USDA and these projects intend to accelerate adoption of BMPs among producers, there often does not appear to be a long-term (i.e., five-year), coordinated I & E plan in place (that integrates public media for dissemination of thematic messages with controlled media for communication of detailed information), or clear definition of audience problem awareness and concern levels. While some states <u>have</u> made significant efforts to integrate public and controlled outlets and develop thematic messages, budget cuts, personnel changes, lack of personnel available to work on I & E only, and conflicting time and resource demands have had impacts on project agendas and priorities. (It also is possible that some of the problems in this area can be traced to what some have called a hasty planning and proposal process.) The low number of long-term I & E plans may also reflect the dynamics of the government planning and budget process; it also appears that government's multiple and demanding priorities hamper long-term planning efforts. Therefore, through evaluating all these contingencies, more clearly defining audience problem awareness levels, and re-evaluating the value of long-term I & E campaign planning, it may be possible for the USDA and its associated agencies to construct

a more thorough definition of I & E and re-evaluate its prioritization in the midst of all the other tasks these projects must juggle.

Finally, to sum up across all the states, good planning, professional communications support, strong interagency communication, teamwork and removal of staff and cost-share obstacles appear to contribute most to setting up forward-moving I & E programs and demonstration projects. If any of these areas is weak, the projects as a whole, as well as their I & E efforts, suffer and project momentum declines.

III. PRODUCER VIEWS

Understanding of baseline producer communication patterns and their attitudes with respect to water quality are a necessary context for viewing their adoption characteristics. First we consider the overall findings across samples, and then turn specifically to site-by-site descriptions. It should be noted that tests were first conducted comparing demonstration versus comparison groups in each state on key variables to assure compatibility. The only variable upon which notable discrepancies were found was awareness of the USDA projects within the demonstration site samples. Scattered inconsistencies appeared occasionally for communication items. In no case were there significant differences between groups on items directly related to awareness, evaluation, or adoption of the BMPs. In the following analyses, in some cases where appropriate, data from demonstration and comparison sites within states are combined, while in other instances demonstration data are used exclusively.

The data reveal several highly consistent trends in producer communication patterns across all demonstration and comparison areas. Not only are these state-by-state similarities noteworthy for subsequent water quality BMP planning efforts, but for enhanced understanding of agricultural communication and media patterns more generally. While we clearly cannot statistically generalize from these findings to other situations, their consistency across such a varied sample of sites suggests at least a certain degree of validity.

A. Information Orientations

Nearly all producers interviewed had heard or read at least something over the previous year about specific things they could do to help protect water quality, and most reported considerably more exposure to the topic. Well over half said they had come across a "fair amount" or "a great deal" of information, scoring 4 to 5 on a five-point scale (Figure 4). The most popular sources of information about water quality protection were farm-specific

media, including farm magazines, newspapers, newsletters, and broadcast programs (Figure 5). Extension and Soil Conservation Service agents, and other government and university sources, were generally second, followed typically by conversations with other farmers, general news media, and commercial sources.

These findings suggest that water quality protection is well into the communication agenda of the vast majority of farmers. The higher ranking of agricultural media as a source is encouraging on two fronts. First, it indicates that the message has successfully gone well beyond the Extension-SCS-university loop of dissemination; second, farm media likely give the issue greater salience and popular legitimacy. That producers hear about it more from other farmers and personal associates than from commercial interests is also notable.

Also encouraging is that nearly all producers paid at least some attention to information about water quality protection when they came across it, and over a quarter said they paid "a great deal" of attention (Figure 6). Importantly, over 90% reported at least "a little" need for more information about protecting water quality, and about 40% or more had either "a fair amount" or "a great deal" such need. Similarly, over 80% had looked for information about appropriate farm management practices, with over a quarter having looked "a fair amount" or more. Somewhat disconcerting, but not unexpected, is that over half of the sample said they had received conflicting information at least some of the time about what would be best for helping protect water quality.

Amplifying on their conversational patterns touched on above, over half talked with other farmers at least "sometimes" about best management practices, and over 80% said environmental regulation was at least sometimes discussed.

B. Attitudes Related to Water Quality

In their assessments of water quality as a problem, it is clear that producers at all sites follow the common trend of seeing it as less serious close to home, but more serious as distance or the locus of inquiry increases (Figure 7). While nearly three-fourths regarded it as a "serious" or "very serious" problem nationwide, less than half saw it as that problematic in their own states. The percentage drops significantly more when referring to farmers' own counties, and to under 10% when the locale shifts to their own farms. This "other people's problem" kind of effect is quite common in public opinion studies across a range of social and economic issues.

However, a telling difference occurs in the respondents' answers to a follow-up item asking how much impact they thought

farmers had on water pollution problems in each of the locations. Here, the direction of responses almost reverses. Only about a quarter said farmers had a "moderate" or "major" impact nationwide. But somewhat greater numbers see an impact on their own states, counties, and farmsteads. This suggests that while many operators may regard water quality problems per se as minimal on their own land, they do see themselves as having a certain amount of control over them. Nevertheless, about half of the sample still see farmers as having little or no impact on water pollution, whether close to home or nationally.

In terms of more specific attitudes, site differences were somewhat stronger (Figure 8). Still, over 40% agreed with the statement that their farm practices had no impact on water quality in their communities. However, over two-thirds agreed that they had a great responsibility to protect water quality in their communities, that BMPs were readily available to them, and that they would be forced to use BMPs through legislation and regulation if they didn't begin using them on their own.

C. Source Preferences

What kinds of sources do producers use most for information to help make overall decisions about their operations? Those most often used were general farms magazines (e.g., Farming, Farm Journal, Successful Farming) (Figure 9). These were typically followed by farm newspapers and commercial farm contacts, including supply dealers, salespeople, buyers, contractors and processors (Figures 10-12). Grouped together next were -- with some site to site variation -- general daily or weekly newspapers, other farmers, Extension publications, family members, general radio or television news, farm radio programs, and Extension and SCS agents. Less often used were specialized farm magazines, farm meetings, workshops and courses, demonstrations and field days, television farm programs, independent consultants, farm lenders, private newsletters, and landlords or tenants.

If nothing else, the above array indicates that farmers exhibit great diversity in their information choices. Somewhat surprising is the relatively high showing for general media sources, suggesting that these may carry more agriculturally relevant -- and perhaps timely -- information than they are typically given credit for.

Frequency of use of sources does not always equate with which are the most useful for specific purposes. Respondents were asked which source they found most useful for a range of activities. For "day-to-day farm production activities," considerable site-to-site variation occurred. Generally, however, the four leading sources included general farm magazines,

commercial interests, family members and partners, and farm newspapers. General newspapers, farm radio, Extension agents and publications, and other farmers also appeared key in many states.

Longer-range production or marketing planning made even more use of general farm magazines, followed typically by family members or partners, commercial dealers and farm newspapers. Some sites gave more emphasis to private newsletters and consultants (e.g., Nebraska), while in others Extension was more utilized (e.g., Maryland).

Looking more closely at the adoption process, general farm magazines, and to a lesser degree farm newspapers, clearly dominated as the most useful sources for awareness of ("first hearing about") new farm practices. Specialized farm magazines, farm radio, Extension publications and agents, and commercial dealers received sporadic mention as well.

In evaluating new practices before the trial stage, however, general farm magazines and other farmers vied for the most mentions. Closely following for evaluation were demonstrations and field days, Extension publications, and commercial dealers. This shift from media to interpersonal reliance between the awareness and evaluation stages replicates numerous adoption model findings over the decades, with the present data providing more detail on specific sources than previous work typically has.

The next step, trial or "learning how to try out new farm practices," shows continuing dependence by many on general farm magazines and other farmers. However, demonstrations and field days approximately tie with those two for number of mentions, with commercial representatives closely behind. Extension agents and publications appear in a second tier of sources.

The most mentioned sources for choosing "the best nutrient and pest management practices" were by far commercial dealers, with independent consultants a significant factor in some states. Extension agents and publications closely followed. For choosing the BMP for crediting manure, however, Extension agents were rated first by far, followed by general farm magazines, Extension publications, family members or partners, and soil and water conservation agents.

Finally, soil and water conservation agents were the most mentioned sources for finding out about the nature and extent of water quality problems in one's local community. They were mentioned by roughly a quarter or respondents across sites, and followed closely by Extension agents. Extension publications, and, importantly, general newspapers, received significant mentions as well.

We should emphasize that while the above findings indicate some clear trends and tendencies, the overall view is one of individual producers using a fair range of information channels, and that producers can differ substantially in the kinds of media they choose.

D. Demonstration Site Findings

Using the above more general findings as a context, we now turn to examining producer communication orientations within each USDA demonstration project target area. For each, we will first call to attention any general communication findings that may deviate notably from those noted above, or that may be of particular interest with respect to project planning or evaluation. Second, we will address results to specific questions about the USDA project per se. Finally, we will include findings relevant to the particular BMPs assessed within that watershed area.

1. Monocacy River Watershed Project

Nearly all farmers in the Monocacy River Watershed Project demonstration target area had heard about specific things they could do to help water quality during the previous year. The dominant sources of such information were government-university related ones, including Extension and soil conservation agents. These were given higher use ratings in Maryland than elsewhere. Monocacy River producers resembled others in attention paid to information about water quality, perceived need for such information, actively seeking it out, and in discussion patterns.

Fifteen percent said water pollution was a "serious" problem on their farms, and other 11% identified it as a moderate one. These proportions were slightly higher than for other sites. Fifty-three percent believed their farming practices had at least some impact on the water quality of their farms. Maryland farmers were more likely than those elsewhere to see pollution as a problem in their own community, and in their own state. However, only about one-third disagreed with the statement that their practices had no impact on water quality, with nearly half agreeing with it. Their responses on the remaining attitudinal measures generally followed the pattern of respondents in other states.

Monocacy River area producers tended to rely more on both general and farm newspapers for decisions about their operations, although general farm magazines were still the most-cited source. Extension publications were ranked just below those, and watershed demonstration project publications were next, ranking

higher than in nearly all other states. Monocacy River project demonstrations per se were rated more highly than those in other states.

While different farmers relied on a variety of sources, general farm magazines were the most valued source for day-to-day and long-range production decisions for most farmers, followed by commercial agents and family members or partners. Magazines again were the main sources for both first hearing about new practices and evaluating them, with Extension publications, demonstrations and field days, and other farmers also often mentioned for evaluation. However, commercial dealers came to the fore in the trial stage, and for choosing nutrient/pest BMPs. Soil and water conservation and Extension agents were the most mentioned sources for choosing manure crediting BMPs, and for finding out about local water quality problems. General newspapers and the USDA project publications received several mentions as well, again more than in other states.

BMP-related information sources. Commercial dealers were named by one-third of the sample as their main source for information about split nitrogen application. General farm magazines and Extension agents followed. For legume and manure crediting, Extension sources were on a par with dealers and magazines.

Project awareness. Nearly 82% of these respondents were aware of the Monocacy River Watershed Project, almost the greatest number among all the states. The highest number first heard of it directly from project publications, with soil and water conservation agents and general newspapers the next most likely sources. Eighty-six percent of those aware of the project also knew about the demonstrations, and nearly one-half of those had visited at least one. Forty-four percent of those aware of the project overall said it had at least some influence on their own operations.

2. Anoka Sand Plain Demonstration Project

All producers interviewed in the Anoka Sand Plain Demonstration project area had at least some degree of exposure to water quality-related information. They were somewhat less likely to have heard about it from government or university sources, however. Information attention and need levels were comparable to those at other sites, but information seeking and discussion levels were slightly lower.

Except for seeing water quality as slightly less of a problem in their communities than was the norm, Minnesota farmers rated pollution problems and farmer impact on them in much the same way as did respondents in other states. However, they were

slightly more likely to agree that their practices had no impact on pollution. Their other attitudes were similar to nationwide averages.

No distinguishing trends appeared in their choice of information sources for making farm operation decisions. Magazines and newspapers again dominated, with Extension publications, commercial dealers, and other farmers following. The USDA project publications and demonstrations were rated slightly lower than in other states. However, commercial agents received the most mentions for making day-to-day decisions, outranking magazines or family/partners. Magazines, however, were named by about half as their main source for hearing about new practices, and also ranked highest for the evaluation and -- unusually -- the trial stages. Minnesotans also ranked general farm magazines more highly for choosing manure BMPs, and to a lesser degree for nutrient/pest BMPs.

BMP-related information sources. Commercial agents, meetings or workshops, and general farm magazines were the most cited sources for split nitrogen application information in Minnesota. Extension agents and family members or partners were mentioned more often for legume and manure crediting, but magazines still topped the list. For irrigation scheduling, meetings and workshops were mentioned by 21%, with other farmers, magazines, and Extension personnel close behind.

Project awareness. These respondents ranked quite low in name recognition of their local USDA project as compared to samples in other states, with 41% indicating awareness. . The sources most named were Extension publications and agents, moreso than at other sites. Of those aware of the project, over three-fourths had heard of the demonstrations, with over one-third having visited one. Twenty-seven percent of those aware said it had at least some influence on their operation.

3. Mid-Nebraska Demonstration Project

Growers in the Mid-Nebraska Demonstration Project region equalled those at other sites for high overall exposure to information about water quality. Farm media were their major overall source for such information, and they tended to rely slightly less on government and university sources and slightly more on commercial ones than producers in other states. In addition, they were about equal to others in attention and need for such information, but discussed the issue somewhat more.

While they did not see water pollution as a bigger problem on their own farms than other producers did, they perceived it as a less serious issue in their communities and in Nebraska overall. They also saw themselves as having more impact on

pollution on their own land than did other producers. They also tended slightly more than others to agree that practices were available to them to protect water, and that they had a responsibility to do so.

Nebraskans differed in several ways with respect to information sources for farming decisions. For one, they relied decidedly more on commercial dealers, who tied with farm magazines as the most cited source. Independent consultants also were used more often, along with demonstrations and field days, radio, family members and partners, private newsletters, landlords/tenants, and lenders. Extension publications were mentioned less, but agents were noted as often as at other sites.

Consultants also turned up more often as sources for day-to-day decisions, with consultants and private newsletters mentioned more for longer term planning. While most mid-Nebraska farmers first heard about new practices from farm magazines, about a quarter named other farmers for information about evaluation and trial. Consultants, demonstrations and field days were more central to evaluation and trial in this project area than they were at other sites.

Dealers or consultants were named by nearly four-fifths of Nebraska growers as their most useful source for nutrient/pest BMP information. Consultants also rival Extension agents as the most cited source of information on the manure BMP. However, Extension and soil and water conservation agents were somewhat more relied on for finding out about water quality problems than they were in other states.

BMP-related information sources. Independent consultants were also the most cited choice (by 34%) for information about split nitrogen application, followed by general farm magazines, and distantly by commercial and Extension personnel (11% each). Consultants tied with magazines for legume crediting (24% each), and with Extension agents for irrigation scheduling (23% each). Over one-third also mentioned consultants most often for deep soil nitrate testing, with 16% citing Extension agents.

Project awareness. Forty-one percent of farmers were aware of the Mid-Nebraska Demonstration Project, with Extension agents and general newspapers the two main sources. Over 80% of those were of it knew about the demonstrations, and nearly one-third of those had visited one. Of those aware of it, 29% said the project had at least some influence on their operations.

4. Water Quality Demonstration Project: East River

Farmers in Wisconsin's East River watershed demonstration area were as exposed as others to water quality BMP information,

and generally heard or read such information from the same kinds of sources. They were slightly less attentive than the norm, but indicated as much of a need for and seeking of such information as producers at other sites.

Their perceptions of the seriousness of water pollution and impact of farmers on it approached the norms of those in other states as well. Two-thirds agreed practices were available to farmers to protect water quality, slightly fewer than average.

Farm newspapers were the most cited source for farm operation decisions in Wisconsin, closely followed by the more typically mentioned general farm magazines. Broadcast programs were mentioned more often than at other sites. Significantly, 72% said they read East River project publications at least "sometimes" for decision making, pushing those into the top range of sources.

Farm newspapers were also the most mentioned source for day-to-day as well as long term decisions, and for becoming aware of new practices. Demonstrations and field days, and other farmers, led the list for evaluation, with commercial agents the most mentioned for trial purposes. Nearly one-half named commercial dealers the most useful source for nutrient/past BMPs, with Extension agents cited by 25% for manure BMPs. Soil and water conservation agents, followed by Extension agents and publications, were the most mentioned for finding out about water problems.

BMP-related information sources. Nearly one-half of the Wisconsin farmers commercial dealers most often cited as their main source for split nitrogen application information. One-fourth named dealers for information about legume crediting, followed distantly by farm newspapers (15%) and independent consultants and Extension personnel (10% each). The same pattern held for manure crediting, with meetings or workshops being somewhat more prominent. Farmstead assessment sources were evenly divided among Extension and USDA project publications, conservation agents and other producers.

Project awareness. A substantial 85% of the respondents reported having heard of the USDA East River project. Virtually all became aware of it through either project or Extension publications, or from personal contact with conservation or Extension agents. Ninety percent of those aware knew of the field demonstrations, with a third of those having attended. Just over half of those knowing about it said the project had at least some influence on them.

5. Rice Water Quality Demonstration Project

Ranchers in California's Rice Water Quality Demonstration Project area had among the highest exposure rates to information about what producers could do to help protect water. Their main sources were conversations with other growers, as well as farm media and government and university channels.

They were also the most attentive to such material, and generally high in need for more of it and in actively seeking it out. They discussed it more often, especially in terms of regulatory possibilities.

Californians were less likely than others to regard water pollution as a problem on their own land, or in their community or state, or nationally. They were, however, closer to the norm in the impact they thought producers had on pollution. Except for feeling greater responsibility to protect water quality, their attitudinal responses were fairly consistent with those of other producers.

The rice ranchers were also more likely to use other farmers and family members for information on day-to-day decisions and long-range planning. Commercial dealers were a significant source as well. Extension agents, as well as other farmers, played more of a role for these producers in first relaying information about new practices; other farmers were clearly the primary source for evaluation and trial of new practices. However, commercial dealers and consultants remained the source named by most for nutrient/pest BMPs. And, government agents and newspapers were most often mentioned for information about water problems in the community.

BMP-related information sources. About one-fifth of the California sample named other ranchers as their main source for information about all four BMPs under study: gravity tailwater recapture, static irrigation, float valve rice boxes, and tail water recirculation. Also cited for each were Extension publications, and Extension and conservation agents.

Project awareness. Nearly one-half of these California ranchers were aware of the Rice Water Quality Demonstration Project, and two-thirds named Extension agents or publications as their information source. Nearly all aware of the project had heard of the demonstrations, and two-thirds of those had gone to one. Of those familiar with the project, 65% said the project had at least some influence on them.

6. Lake Manatee Watershed Project

Growers in Florida's Lake Manatee Watershed Area were slightly less exposed to water quality information than other producers, but their information sources were generally consistent with reports from other sites. They were also somewhat more attentive to and needful of such material, and discussed it more.

These Florida respondents also saw water pollution as less of a problem than other producers, and farmers as having less impact on it. They also reported feeling they had less impact on water pollution, and less responsibility for it.

For general information about their farm operations, specialized magazines and Extension publications were mentioned most often, with Extension and conservation agents listed closely behind. General newspapers, general farm magazines, and broadcast media were named less than at other sites. Extension agents ranked particularly high for both day-to-day and long-term decisions, with other farmers mentioned more often as well. Specialized magazines, however, were the dominant source, especially for first hearing about new practices. Other farmers were the most prominent source for evaluation, closely followed by Extension agents, who took the lead for the trial stage. Extension personnel were also more highly rated than in other states for nutrient/pest and manure BMP, and local water quality, information.

BMP-related information sources. Extension personnel were by far the most cited sources for information about water table monitoring and fully closed seep irrigation. For system uniformity and efficiency, conservation and Extension agents, and commercial dealers, were closely ranked. Agents were the most mentioned sources with respect to soil moisture tests. Agents, commercial dealers and other farmers were grouped as the main sources for multiple application of nutrients, and agents and dealers the top choices for improved fertilizer management.

Project awareness. Just over one-half of the sample had heard of the Lake Manatee Watershed Project, with Extension personnel and project publications the most cited sources. Of those, 63% had heard of the demonstrations, and 44% indicated the project had some or more influence on them. A third of those aware had seen a demonstration.

7. Herrings Marsh Run Watershed Project

North Carolina producers in the Herrings Marsh Run Watershed project target area were slightly above average in exposure to information about water quality, and were the most likely to name government or university sources for the material. They did not substantially differ from other producers with respect to other information orientation.

Nor did they differ from others in perceptions of water pollution problems, except to regard pollution as a somewhat more serious issue in their communities and state, and believing farmers had more of an impact in those areas. The North Carolina sample did exhibit a greater sense of responsibility for water problems, but were fairly consistent with other producers on the other attitude dimensions.

Farm newspapers, general farm magazines, and Extension publications were the most mentioned sources for overall decision making. Lower-than-average ratings were given farm meetings, field days and demonstrations. General newspapers and farm magazines were most apt to guide day-to-day decisions, with the latter ranked first for long-term planning, as well as first hearing about new practices. Extension sources were the new practices mentioned for new practice evaluation and trial. Extension agents were named more often than usual for nutrient/pest BMPs, ranking close to commercial dealers. Soil and water conservation agents were cited by nearly one-half the sample as the most useful reference for local water quality problems.

BMP-related information sources. One-half of the North Carolina sample cited Extension publications as their main source of information about poultry composting. Far behind were Extension and conservation agents, project demonstrations, and farm newspapers.

Project awareness. One-third of the respondents had heard of the Herrings Marsh Run Watershed Project, and most learned of it from Extension or conservation agents. Of those, 55% said it had some influence on their farm operations. Nearly two-thirds had also heard of the demonstration projects, and just over one-half of those had attended one.

8. Seco Creek Demonstration Project

Texans in the Seco Creek Demonstration Project target group had relatively higher exposure levels of information about what they could do to help protect water quality. However, both government and commercial sources were rated slightly lower than

in other states, and general news media slightly higher. Their other information characteristics were similar to those of producers at other sites.

These respondents were less likely than others to regard water quality as a problem on their own land, or in their state. However, 97% agreed that they had a great responsibility to help protect water quality, and their overall attitudes followed those reported for other states.

As for information sources for farm operation decisions, they were less apt than other respondents to use nearly any of the print sources, including farm magazines and Extension publications. Their use of other sources was not particularly different from other states, except for being lower over all in many cases. Radio appeared to play a stronger role in day-to-day and longer term decisions. However, the most listed source for becoming aware of new practices were Extension publications, followed by general farm magazines. Demonstrations and field days were the most cited for evaluation and trial. Commercial dealers and Extension agents and materials scored higher for choosing nutrient/pest and manure BMPs. For water problems, they turned more to general newspapers, conservation agents, and Seco Creek project publications.

BMP-related information sources. Conservation agents were the most mentioned information sources for rangeland reduced herbicide use, and they tied with other farmers for riparian area management. Other farmers and project publications were most often cited for information about prescribed burning.

Project awareness. Eighty-five percent of the sample was aware of the Seco Creek Demonstration Project. Most had heard of it either directly from project publications, or from general newspapers. Nearly all were also aware of the demonstration project, and one-third had visited one. Over 40% of those familiar with the project said it had influenced their operation.

Subsequent analyses will take a more detailed look at the above findings as related to research adoption models and variables, and in the context of the adoption hypotheses and questions posed previously.

IV. EXTENT OF USE OF SELECTED BMPS IN 1991-92

A subset of practices being promoted by each state demonstration project were selected for adoption process measurement. The subset was chosen through a combination of the technology classification process and the priority of the practices as identified by state demonstration project staff.

The following is a brief summary of adoption processes surrounding these selected practices follows.

Two different measures of adoption were used in the baseline study. The first is a scale that illustrates the approximate stage of adoption by practice and state. This adoption stage scale is based on awareness of the remedial practice, claimed level of familiarity with the practice, and claimed use of the practice. Individuals were classified as being in one of the following stages of adoption relative to each practice: unaware, interest, evaluation, trial, or adoption based on combined responses to these three questions. This adoption scale does not account for knowledge of the practice, accuracy in adoption among those claiming use, and extent of use for those claiming adoption. Refinements in claimed versus actual adoption based on accuracy and extent will be added after the next wave of data collection.

The second composite measure used in the baseline report is based on the perceived characteristics of each practice. Again this is presented by state and practice. These are characteristics past research has found to be critical in the adoption process. The overall scale is based on perceived scores relative to; 1) expense, 2) labor requirements, 3) complexity, 4) difficulty in using, 5) practicality, 6) risk, 7) profitability, and 8) ease of obtaining information. Individual scores on each of these characteristics for each practice were summed and standardized to create an overall scale value.

The adoption data highlight two facts about the demonstration projects. First, the projects are involved with both old and new practices. Some of the practices being promoted are innovative and will require significant information transfer and assistance to promote adoption. Others, however, have been available to landusers for some time. These latter practices will require different promotion strategies based on addressing stereotypes and barriers to adoption. The second fact surrounding the demonstration projects is the diversity in practices being promoted. In addition to currency, these practices vary in managerial expectations, labor and capital investments, risk and a number of other factors. One promotion technique will not work for all practices within any one demonstration project.

A. Stage of Adoption

Consistent with the findings from the communications section, diversity between and within project areas characterize the stage of adoption results. The majority of respondents claimed to be aware of all practices in all states with the exception of the farmstead assessment system in Wisconsin, split

application of nitrogen in Texas, and irrigation scheduling in Minnesota. Other instances where at least a quarter of the respondents were not aware of practices include split application of nitrogen in Wisconsin, soil moisture tests for Florida citrus growers, manure crediting in Maryland and North Carolina, and poultry composting also in North Carolina. Creating awareness for the remainder of the practices should not be an issue for the demonstration projects.

A majority of respondents are in the interest or evaluation stages for the split application of nitrogen in Maryland, Wisconsin, Minnesota and Nebraska, deep soil nitrate tests in Nebraska, legume crediting in Maryland and Minnesota, manure crediting in North Carolina and Minnesota, poultry composting in North Carolina, and all four irrigation systems (tailwater recirculation, gravity tailwater, static-Pearson, float valve rice box) in California. Providing critical agronomic and economic information in a persuasive context will be the challenge facing the demonstration projects relative to these practices. Also important is the fact that "unlearning" can be as important as "learning" in the evaluation and trail stages. Countering ambiguous, stereotypical or inaccurate information can often be more important than simply supplying more information.

There are some situations where a significant number of producers are already using the practices being demonstrated. This includes over three-quarters of Florida citrus growers who are in the trial stage relative to using multiple nutrients. At least half of the Texas respondents said they had already adopted mechanical brush control and soil testing. The same can be said of Florida vegetable producers relative to improved fertility management and enclosed seep irrigation systems. At least half of the North Carolina respondents said they had already adopted the practice of split application of nitrogen. A similar situation exists in Nebraska relative to irrigation scheduling. In these situations the demonstration projects need to focus on land users who have not already adopted the promoted practices.

B. Overall Perception of Practices

The eight individual perception scores summarized into an overall score give an indication of judgements toward the practices being promoted. The difference between scale sums and one hundred percent represent those who could not form a perception about a specific practice. Most practices have the scale medium at or below the midpoint on the seven-point scale. Exceptions include the farmstead assessment system in Wisconsin where a third (38.5%) give the lowest three ratings, 16.0 percent give it a higher rating, and the remainder were unable to form an assessment. On the other end of the spectrum, over half (56.9%) of the respondents in Nebraska gave split application of nitrogen

a positive score in the upper three scale categories.

In general, scores in the lower three categories of this summated scale will be interpreted as negative, the middle category as neutral, and the upper three categories as positive. Negative values imply either a lack of information on which sound assessments can be based, or the lack of assistance to overcome well documented obstacles. Positive scores indicate possessing adequate amounts of information for a sound assessment and no major perceived obstacles to adoption.

C. Demonstration Site Findings

The following is specific information on the previously noted general trends. Both stage of adoption and overall perception will be given by practice and by demonstration project.

1. Monocacy River Watershed Project

(See Figure 13 for Stage of Adoption and Figure 22 for Overall Perception of Practices)

Farmers in Maryland were given an explanation of three farm management practices; manure crediting, legume crediting, and split application of nitrogen. These three were from among those being promoted by the Monocacy River Watershed Project. Manure crediting has the lowest level of adoption. There are 53.8 percent who are in the unaware or interest stages relative to this practice. This is matched by the 59.8 percent who gave this practice a rating in the lower three categories of the perception scale. A little over a third (38.8%) were in the trial or adoption stage relative to manure crediting. However, there are still problems as only 5.0 percent gave this practice a score in the upper three categories of the perception scale.

Legume crediting had a quarter (24.6%) claiming adoption, another 3.0 percent in the trial stage, another quarter (24.6%) in the evaluation stage, and the remainder (47.8%) just about evenly split between being either interested or unaware of this practice. Over half (58.9%) had a negative perception (lower three response categories) of this practice while only 4.3 percent had a positive perception.

The split application of nitrogen had two-fifths (39.1%) in the unaware or interest stages, and half (50.4%) in the evaluation stage of adoption. Approximately one in ten (9.8%) claimed adoption while less than a percent (0.8%) were in the trial stage. There were 54.6 percent who currently held a negative perception of the practice, another 24.8 percent who were neutral, and a quarter (26.2%) who were positive toward this practice.

2. Mid-Nebraska Demonstration Project

(See Figure 14 for Stage of Adoption and Figure 23 for Overall Perception of Practices)

Four practices are being promoted in Nebraska as part of the demonstration project. These are legume crediting, split application of nitrogen, irrigation scheduling and the deep soil nitrate tests. The largest category of respondents relative to legume crediting were claiming adoption (39.0%). Another 6.2 percent were in the trial stage, and a fifth (19.2%) were in the evaluation stage. Another fifth (21.2%) was in the interest stage, and 14.4 percent were classified as being in the unaware stage of adoption. Over half (56.9%) of the respondents had a negative perception of legume crediting. Another fifth (20.3%) were neutral and 13.0 percent were positive.

The split application of nitrogen found just under a fifth (18.9%) claiming adoption while the majority (67.6%) were in the evaluation stage. Only 4.7 percent said they were unaware of this practice. Another 8.8 percent were aware and interested in this practice. Only 11.3 percent had a negative perception of this practice. Two-fifths (39.7%) had a neutral perception, and 56.9 percent had a positive perception.

Irrigation scheduling had over half (52.1%) claiming adoption yet only 24.4 percent had a positive perception of this practice. Another fifth (26.4%) were in the evaluation stage while less than a fifth (15.7%) were in the interest or unaware stages of adoption. Two-fifths of the respondents scored on the lower three response categories of the perception scale while 31.8 percent were at the midpoint on this scale.

Deep soil testing of nitrate had 31.1 percent claiming adoption, another 2.0 percent in the trial stage, and half (50.7%) in the evaluation stage. Few (16.2%) were in the unaware or interest stages relative to this practice. A third (34.5%) held a neutral perception of this practice. Over half (53.5%) were negative, and 9.5 percent were positive.

3. East River Water Quality Demonstration Project

(See Figure 15 for Stage of Adoption and Figure 24 for Overall Perception of Practices)

Four different practices were studied from among those being promoted in the Wisconsin demonstration project. These were manure crediting, legume crediting, split application of nitrogen and the farmstead assessment system. A fifth (21.0%) of the farmers said they were unaware of manure crediting as being promoted. Just about equal numbers were in the interest (15.1%)

and evaluation (16.9%) stages of adoption. Another 12.6 percent were trying this practice on a small scale while a third (34.2%) claimed full-scale adoption. Almost two-thirds (64.8%) however, scored in the lower three categories on the perception scale. A fifth (20.8%) was neutral or at the midpoint on this scale, and only 5.3 percent scored positive.

The responses to legume crediting were similar to those of manure crediting. That is, 38.5 percent claimed adoption, few were in the trail stage (9.2%), a fifth (20.2%) were in the evaluation stage, and about equal number were either interested (13.8%) or unaware (18.3%) of this practice. Perception scores found almost two-thirds (63.5%) held a negative perception, a fifth (23.3%) being neutral and only 2.6 percent being positive.

Over a quarter (26.9%) of the respondents were unaware of the practice involving split applications of nitrogen. There were 16.7 percent who were interested, and two-fifths (39.4%) who were in the evaluation stage. Few (1.9%) were in the trial or adoption (15.3%) stages of adoption relative to this practice. There were 29.4 percent who had a negative perception of this practice, and 30.3 percent who were neutral. Approximately a quarter (26.7%) held a positive perception.

The farmstead assessment system found most (80.4%) being unaware of the practice. Few were in the interest (8.7%), evaluation (5.5%), trial (2.3%) or adoption (3.2%) stages. This is matched by the 38.5 percent who hold a negative perception, 8.9 percent being neutral, 7.1 percent being positive and the 45.5 percent who could not form an assessment of this practice.

4. Rice Water Quality Demonstration Project

(See Figure 16 for Stage of Adoption and Figure 25 for Overall Perception of Practices)

The California demonstration project is promoting four practices associated with irrigation in rice production; tailwater recirculation system, gravity tailwater recapture system, static (Pearson) irrigation system and float valve rice boxes. As will be seen, for three out of these four practice the majority of respondents were in the evaluation stage of adoption. This implies the necessity of providing the detailed agronomic, engineering and economic information in a persuasive context. Generalized promotion messages would not be appropriate.

Two-thirds (67.2%) of the respondents were in the evaluation stage relative to the tailwater recirculation system. Another quarter (25.0%) claimed full-scale adoption of this practice. There were 7.8 percent in the interest stage of adoption. Just over a quarter (26.6%) held a negative perception of this

practice, a third (35.4%) were neutral, and 35.5 percent were positive.

The gravity tailwater recapture system had 7.8 percent in the adoption stage, half (54.7%) in the evaluation stage, 14.1 percent interested, and 23.4 percent being unaware of the practice. There were 44.6 with a negative perception of the practice, a fifth (21.5%) neutral, 23.0 percent positive.

The static (Pearson) irrigation system had 4.7 percent claiming use, 60.9 percent in the evaluation stage, 18.8 percent interested, and 15.6 percent unaware of the practice. There was a third (34.3%) holding a negative perception, 29.2 percent neutral, and a quarter (24.6%) with a positive perception.

The final practice evaluated, the float valve rice box, had only 1.6 percent claiming adoption. Just over two-fifths (43.8%) were in the evaluation stage. The remainder were either in the interest (26.6%) or unaware (28.1%) stages of adoption. Almost half (44.6%) scored in the lower three perception scale categories. There were 18.4 percent who were neutral, and a fifth (19.9%) who were positive.

5. Anoka Sand Plain Demonstration Project

(See Figure 17 for Stage of Adoption and Figure 26 for Overall Perception of Practices)

The Minnesota demonstration project involved four practices being evaluated; manure crediting, legume crediting, split application of nitrogen and irrigation scheduling. The highest level of claimed adoption was for split application of nitrogen. There were 44.0 percent of all respondents who claimed adoption of this practice. While none were in the trial stage, another 35.8 percent were in the evaluation stage. Only 7.3 percent were in the interest stage while 12.8 percent were unaware of this practice. Just under two-fifths (38.5%) had a negative perception of split nitrogen applications. A third (33.9%) were neutral, and 13.8 percent were positive.

Manure and legume crediting share similar stage of adoption findings. Approximately a fifth were unaware of manure (22.9%) and legume (17.4%) crediting. Another fifth were in the interest stages for manure (22.9%) and legume (18.3%) crediting. Just under a third (30.3%) was in the evaluation stage relative to manure crediting while 34.9 percent were in the same stage for legume crediting. Trial was claimed by 10.1 percent for manure crediting and 5.5 percent for legume crediting. Yet while almost a quarter (23.9%) claimed adoption of legume crediting, there were only 13.8 percent who said the same for manure crediting. Perceptions on these two practices also were similar with a

majority holding a negative perception, a fifth neutral and very few holding a positive perception.

Irrigation scheduling had three-fifths (60.0%) not being aware of the practice. Less than a fifth (17.3%) were in the interest, evaluation or trial stages. Just over a fifth (22.7%) claimed full scale adoption of irrigation scheduling. Only one tenth of the respondents had a positive perception while 45.0 percent had a negative perception. Just under a fifth (17.5%) had a neutral perception of the practice.

6. Lake Manatee Watershed Project

(See Figure 18-19 for Stage of Adoption and Figure 27 for Overall Perception of Practices)

A total of seven different practices are being promoted to the vegetable or citrus growers in the Florida demonstration project. For the vegetable growers this included improved fertility management involving soil and tissue testing, water table monitoring, enclosed seep irrigation systems and irrigation scheduling. Irrigation scheduling was also promoted to the citrus growers along with multiple application of nutrients, irrigation system testing and soil moisture tests.

The majority of Florida vegetable growers are already claiming adoption of improved fertility management (58.3%) and enclosed seep irrigation (66.7%). Yet there were also 16.7 percent who were unaware of the improved fertility management practice, and 22.2 percent who were unaware of enclosed seep irrigation. Another 12.5 percent and 11.1 percent were only in the interest stage relative to improved fertility management and enclosed seep irrigation, respectively. There were 36.0 percent who had a negative perception of improved fertility management and 24.0 with the same perception toward enclosed seep irrigation. Just over a third (36.0%) were neutral toward improved fertility management while the comparable statistic for enclosed seep irrigation was 24.0 percent. A third (36.0%) were negative to improved fertility management while only a quarter (24.0%) had the same perception of enclosed seep irrigation.

The other two practices relevant to vegetable growers, water table monitoring and irrigation scheduling, both had two-fifths (40.0%) claiming adoption. The statistics for irrigation scheduling also include the citrus growers. No one claimed the trial stage for water table monitoring while 6.7 percent claimed this for irrigation scheduling. A quarter (26.7%) of all Florida respondents claimed to be in the evaluation stage for irrigation scheduling. Only a fifth of the vegetable growers were in the evaluation stage relative to water table monitoring. Just under a fifth claimed to be unaware of irrigation scheduling (18.7%)

and water table monitoring (16.0%). Irrigation scheduling had a half (49.3%) with a negative perception, a quarter (24.7%) with a neutral perception, and 14.9 percent with a positive perception. Water table monitoring had 64.0 percent of the vegetable growers with a negative perception, 28.0 percent being neutral, and only 4.0 percent positive.

Most (79.5%) citrus growers were in the trial stage relative to multiple nutrient applications. Another 11.4 percent were in the evaluation stage. Less than 10 percent were either unaware or only interested in this practice. Just over two-fifths (44.7%) had a negative perception, 30.4 percent were neutral, and 18.0 percent were positive toward multiple application of nutrients.

Two-fifths (40.7%) of the citrus growers claimed adoption of irrigation system testing. Another quarter (25.9%) was in the evaluation stage while the remainder were in the unaware (16.7%), interest (9.3%) or trial (7.4%) stages of adoption. There were 14.3 percent who had positive perception of this practice, a quarter (26.8%) neutral, and 44.8 percent negative.

Soil moisture tests for citrus growers had only 11.3 percent claiming adoption. A fifth (20.8%) were in the trial stage with approximately the same number being in the evaluation (18.9%) and interest (20.8%) stages of adoption. There were 28.3 percent who claimed to be unaware of this practice. A quarter of these growers held a neutral perception relative to this practice. While 16.2 percent held a positive perception, the largest response category was the 46.5 percent who held a negative perception.

7. Herrings Marsh Run Watershed Project

(See Figure 20 for Stage of Adoption and Figure 28 for Overall Perception of Practices)

Two practices were being promoted among crop producers in North Carolina (manure crediting and split application of nitrogen) while one practice was fostered for poultry producers (dead bird poultry composting). Almost two-fifths (37.2%) of crop producers were not aware of manure crediting. A quarter (26.9%) was in the interest stage. Another quarter (26.9%) was in the evaluation stage. Only 1.3 percent said they were trying this practice on a small scale. There were 7.7 percent who claimed adoption of manure crediting. There were 10.0 percent of respondents who had a positive perception of the practice, 38.0 percent neutral, and 41.0 percent who were negative.

Half (50.6%) of the crop producers claimed to already use split application of nitrogen. Few (1.3%) were trying this

practice on a small scale. There were 29.9 percent who were evaluating the practice while another 2.6 percent were expressing interest. Only 15.6 percent claimed to be unaware of this practice. Even though half claim use, only 9.0 percent gave this practice a positive rating on the perception scale. Two-fifths (41.0%) were neutral, and 46.3 percent were negative.

None of the poultry producers claimed adoption or trial of the poultry composting system. This was to be expected as the first system was just being established in the watershed. There were 36.4 percent who were evaluating the practice based on current information, and an equal amount in the interest stage. Another quarter (27.3%) claimed to be unaware of this practice. Almost a third (31.7%) gave this practice a positive rating on the perception scale. This was balanced by the 45.3 percent who had a negative perception. Only 13.6 perception were neutral toward poultry composting.

8. Seco Creek Demonstration Project

(See Figure 21 for Stage of Adoption and Figure 29 for Overall Perception of Practices)

Four of the practices associated with the Texas demonstration project are covered in this report. This includes soil testing and the split application of nitrogen for crop producers, and prescribed burning and mechanical brush control for those producers managing rangeland. Soil testing had half (50.0%) of the Texas crop producers claiming full scale adoption. Another fifth were in the trial (11.9%) and evaluation (9.5%) stages of adoption. Just under a fifth (19.0%) were in the interest stage, and 9.5 percent claimed to be unaware of this practice. The 31.6 percent with a negative perception of this practice was matched by the 33.7 percent who were neutral. There were 13.1 percent who had an overall positive perception of soil testing.

The split application of nitrogen had only 12.2 percent claiming adoption while none were in the trial stage of adoption. A quarter (24.4%) were in the evaluation stage and 12.2 percent expressed interest in the practice. The largest response category was the 51.2 percent who were unaware of split applying nitrogen in crop production. This lack of familiarity is consistent with the perception of this practice. There were 17.6 percent with a negative perception, 13.1 percent neutral, 6.6 percent positive, and 62.7 percent who were unable to provide an assessment of this practice.

Just over a third (34.9%) of those with rangeland claimed to be using prescribed burning as part of their operation. Another 2.3 percent were in the trial stage where it was being tried on a

small-scale basis. The remaining respondents were fairly evenly divided among those in the evaluation (18.6%), interest (23.3%) and unaware (20.9%) stages of adoption. A fifth (20.7%) had a positive assessment of this practice, just under a third (31.5%) being neutral, and 36.0 percent being negative.

Almost two-thirds (61.4%) of operators with rangeland claimed to be already using mechanical brush control. Few were in the trial (2.3%), interest (4.5%) or unawareness (6.8%) stages of adoption. A quarter (25.0%) were currently evaluating this practice. A quarter (26.2%) had a negative perception of the practice, a third (33.7%) were neutral and 13.1 percent were positive toward mechanical brush control.

V. PROVISIONAL RECOMMENDATIONS

Realistic recommendations concerning UDSA water quality project planning need to carefully take into account the individual situations at each of the eight sites. As noted previously, each site incurs (a) specific watershed circumstances, (b) varying types of BMPs, (c) differing information and communication environments, and (d) somewhat distinctive project organizational makeups and capabilities. As such, provisional general recommendations include:

1. Project planners need to take into account not only existing producer awareness, attitudes and behavior regarding water quality and BMPs, but producer communication environments and patterns as well. The above findings regarding producer views, communication patterns, and current usage of BMPs need to be carefully assessed and integrated by USDA staff and State Cooperators. Planners should also rely on experiences with their own clients, and use the above findings to sharpen and enhance those perceptions.

2. As we have identified in Appendix A, and more extensively as in the 1992 Background Working Report, certain information and education strategies appear to have had more success than others. We have emphasized those that may be particularly relevant to producer adoption of water quality BMPs, and refer interested parties to this material. It is particularly appropriate to recommend use of well-tested models of communication, education, and development in planning project strategies and tactics. Centering a campaign around a more "theoretical" model not only allows a broader base of knowledge to be brought to bear on the problem, but it also provides a guiding structure that can help order the sometimes complex and disorganized components of many sophisticated communication programs.

In this case, the basic components of the familiar adoption model (awareness, evaluation, interest, and adoption of given

BMPs) can be highly useful. Its application to the BMP usage findings in Section IV points out several avenues for subsequent demonstration planning. In a more general sense, a model of water quality competence on the part of producers can also be useful in guiding approaches to increasing awareness, positive attitudes, capabilities, and action with respect to water quality problems and solutions.

3. Our sense is that program planners could go further in delineating more clear and specific project goals. Planners need to specify at a minimum what kind of impact goals are being aimed at, including the options of awareness, information gain, attitude change, motivation, and behavior change. Criteria should be established at the outset -- by project leaders -- to allow subsequent judgement of the "success" or "failure" of components of the program. Such criteria can be as basic as wanting 30% of all farmers within a county to have read a particular newsletter, or 20% to be aware of a prescribed BMP within six months, or 40 farmers to attend a given demonstration.

4. More extensive use could be made in some cases of basic informational, educational, and marketing techniques in program design and execution. These include such design elements as concept testing, focus group analysis, pretesting of materials, and tracking the dissemination of media and related materials. Know what works for the local community before investing too much into it.

More specific guidelines at this point based upon the findings include:

1. The vast majority producers appear aware of water quality as an issue. Rather than repeating its general importance -- which could lead to boredom or tuning out -- try to canalize the message more directly to individual farm situations. This is already taking place to some extent, but the trick is to avoid simply duplicating water quality as the key theme and build more specific subthemes. Examples could include soil degradation <u>as related to</u> water quality; legume crediting <u>as applied to</u> water quality, and so forth.

2. Work with farm magazines and related publications. These appear to be used considerably for the kinds of information that needs to be gotten across. They can provide more details in permanent readily-accessible form than many other media. Press releases to magazines are always useful, but careful nurturing of one-on-one relationships with appropriate editors and writers can be more significant. Invitations to demonstration projects, sharing of research findings, and the like can bear considerable fruit.

3. Share with producers the finding that they as a group see

water pollution as less of a problem at home than further away. Obviously, it can't always be "someone else's problem." It might be worth getting active discussions going on this, tied to local situations and needs.

4. Build on what appears to be a heightened sense of responsibility among producers to help protect water quality, as well as their concerns over government intervention. The first might be viewed as a more positive stimulus for change than the second.

5. The findings clearly document that producers use a vast array of information channels. No one channel -- including demonstration farms alone -- will begin to develop the degree of exposure, information gain, or competence required to accomplish significant BMP adoption rates. Think multi-channel, multi-media, but with shared, reinforcing themes. Capitalize on the differences across sites noted in the findings above for channels to emphasize (but not use exclusively). Just to indicate a few examples, in Nebraska, commercial dealers and consultants may be brought more into the mix as appropriate. While dealers are important for split nitrogen and crediting in Maryland and Wisconsin, farmstead assessment sources in the latter are likelier to be government-tied. Minnesotans are clearly more varied in that their use of sources is more tied to the particular type of BMP. Discussion with other ranchers are important to California's rice growers. Florida producers rely more on Extension and soil conservation staff, while Extension publications appear used more in North Carolina. Interpersonal sources such as county agents and other producers seem more of a key in Texas.

6. Similarly, the BMP use and adoption findings detailed in Section IV need to be taken into account in subsequent planning. Again, considerable variation is found across both states and BMPs. Each project needs to consider current BMP awareness, evaluation and use patterns, and apply those to their demonstration and information/education efforts, again in the context of their own experiences and abilities.

In sum, project personnel should turn to the above findings for both national level strategies and local tactics. These should be carefully integrated with personal experiences at local sites, and with the capabilities of local resources. Site-specific recommendations directed at project leaders are in preparation.

APPENDIX A

THEORY AND RESEARCH BACKGROUND

This evaluation of the USDA 1990 Water Quality Demonstration Projects occurs in the context of theory and past research. These need to be reviewed to provide the justification for the methods and techniques used in the evaluation process. The review inter-relates four major areas: best management practices, on-farm demonstrations, adoption of farm practices and communication processes.

BEST MANAGEMENT PRACTICES

A BMP has been viewed as an evolving array of practices for managing animals, crops, water, or land; controlling erosion or drainage; utilizing nutrients; and controlling pests. In order to be acceptable these practices must balance agronomic and environmental effectiveness, economic feasibility, and social acceptability (Bailey and Waddell, 1979). Several key dimensions exist in this definition of a BMP. First it implies that a BMP is not fixed in either time or space. Instead, a BMP must constantly evolve or be adapted to meet changing technologies, economies, and farm systems. Second, a true BMP must be more than just agronomically and environmentally sound. It must also be socially and economically acceptable to both the organizations promoting the technology as well as to the individuals who are expected to adopt this practice.

A BMP designed for agrichemicals and water quality can be designed around one or more of four basic dimensions. First, the BMP can demonstrate how to reduce the use of the agrichemical. Second, it can improve agrichemical application efficiency. Third, it can be built around more "environmentally acceptable" chemicals. Fourth and finally, a BMP can be based on nonchemical alternatives. Within each of these dimensions, as well as combinations across dimensions, are a multitude of alternatives that can meet the agronomic and environmental criteria. However, even with this flexibility the underlying challenge remains the same. Before this best management practice can truly be a Best Management Practice, it must be socially and economically acceptable to the target audience.

An important objective of USDA water quality undertaking will be to demonstrate that current technologies can be acceptable along social and economic dimensions. That is, experts affirm that there are practices that meet the criteria of being agronomically and environmentally sound. USDA has initiated a number of activities that will test the degree and extent of the social and economic acceptability of these

practices.

ON-FARM DEMONSTRATIONS

On-farm demonstration has a long history in the United States predating the formation of both the United States Department of Agriculture and Land Grant University system in 1862. Recently there has been a resurgence of interest in on-farm demonstrations. This renewed interest is often associated with sustainable agriculture, water quality best management practices and other efforts to reduce negative social and environmental impacts of agricultural activities.

Interest in on-farm demonstrations is also tied to an increased awareness by agricultural researchers of the constraints farmers face when evaluating new technologies or practices. Farmers are not free to choose any or all of the many new technologies or practices that emerge each year. Moreover, formal communication efforts often lack the type of information needed by farmers to accurately evaluate these practices (Krome, 1989; U.S. Congress, 1988). Researchers and program administrators are recognizing that on-farm demonstrations are one way of addressing certain of these constraints to adoption. That is, there is increasing recognition that a well-designed on-farm demonstration can accelerate the voluntary adoption of recommended practices.

Working Definitions

Confusion exists over exactly what constitutes such an activity. The situation is confounded when the terms on-farm demonstration and on-farm research are used synonymously. Many activities are called "on-farm research" when no formal agricultural research is being conducted. Conversely, "on-farm demonstration" has been used to describe formal agricultural research activities conducted on a farm. In basic terms, on-farm research has the primary objective of knowledge generation under a number of specific conditions while employing standardized methods. On-farm demonstration has the primary objective of knowledge dissemination.

At a fundamental level, on-farm demonstration uses the outcome of experiential learning ("learn by doing") to extend these results by means of observational learning ("learn by seeing") through community or agricultural networks. This implies that the cooperating farmer "learns by doing," and then passes on the information gained by giving neighbors and others in social and kin networks the opportunity to learn by observing (Wake et al., 1988). The farmer managing the demonstration effort may have either developed the technique, be cooperating with change agency personnel, or observed the technique elsewhere and adapted it to

local conditions. On the other hand, on-farm research implies use of basic or applied analytical techniques where both randomization and control of treatment effects are used. The primary objective of research, on-farm or elsewhere, is to discover unknown facts or to explain variation in the phenomena under investigation. This is very different from on-farm demonstration where the primary objective is to disseminate known research results in an effort to change farmer behavior.

Dimensions of On-Farm Demonstrations

A critical dimension in on-farm demonstrations is the amount of input and control the hosting farmer has over the demonstration. Ashby (1986) has identified three broad levels of farmer input and control.

1) Nominal participation by farmers, and where researchers or change agency personnel manage and implement the demonstration. Its purpose is to gain acceptability of practices or methods by farmers. This type of demonstration does not generate any information about how farmers respond to the practice or method.

2) Farmers play a consultative role with researchers or agency personnel in problem and solution definition. Here the emphasis is on farmer circumstances, recognizing that farmers have subjective goals and preferences as well as objective situations about which they need to be consulted. However, it is important to note that the practice or method has already been screened by researchers or agency personnel.

3) The farmer participates in a decision-making role. This is characterized by farmer involvement in all aspects of the demonstration. Farmers not only specify the problem, but also are responsible for developing the remedial practice or method. This type of on-farm demonstration also allows farmers to make judgments independent of researches or agency personnel about implementation or evaluation.

It is suggested that at least four features should define the level of farmer involvement required: (1) the scope of the practice, ranging from practices to methods to farming systems; (2) level of past participation and cooperation of the target audience, with greater past cooperation typically requiring less farmer involvement; (3) existing level of problem recognition, with greater recognition requiring less farmer involvement; and (4) the profitability of the demonstrated practice, i.e. those that become profitable only with financial assistance from the government requiring less farmer involvement.

A second dimension is the accessibility of the on-farm demonstration to other farmers. This includes several features, but generally refers to the ease in which other farmers can gain access to the information across time and space. Temporal accessibility can vary between one-time field days to informal and unguided tours or site visits available across the whole production cycle. Spatial accessibility refers to distance to other farms, location of the demonstration relative to public roads, and location within the farm operation.

An often overlooked, but critical third dimension of on-farm demonstration is the degree the host farmer and farm is representative of the surrounding farm community or the target audience. An implicit objective is for the demonstration farmer to become a role model in the use of the technique being demonstrated. Acceptability of the demonstration to the target audience is directly related to the farm and farmer hosting the demonstration. The social position of the demonstration farmer needs to be assessed: the community or "opinion leader" is the ideal host of a demonstration effort in order to allow the "trickle down" processes behind the concept to work.

Also important is an assessment of how representative the demonstration farm is relative to other farms in the targeted area, along physical, enterprise, economic, and social dimensions. Ideally one selects a demonstration farm that is representative of the target audience of the demonstration.

THE ADOPTION OF AGRICULTURAL PRACTICES

Understanding the nature and rationale of on-farm demonstrations necessitates an understanding of how farmers become aware of and begin using new practices, as well as technologies. A large body of research within the social sciences studies why individuals adopt practices and technologies. This body of work has developed into a widely recognized model known as the adoption-innovation diffusion theory (see Buttel, et. al., 1990:46-72). The pioneering work of Ryan and Gross (1943) investigating the introduction and use of hybrid seed corn in Iowa between 1928 and 1941 was one of the first studies employing this model. It is considered the classical study of the adoption-diffusion process in agriculture.

Adoption vs. Diffusion

Although there is a tendency to treat adoption and diffusion as discrete events, both of these concepts represent processes. That is, both adoption and diffusion represent a related series of events that occur across time relative to an innovation. An innovation is any practice or idea perceived as new or different

by the target population. Adoption is the process where the adopting unit, often an individual, moves through a series of identifiable stages toward incorporating an innovation into the farm operation. Diffusion is the spatial dispersion of this innovation across the farm population, i.e., the cumulative pattern of adoption decisions. Diffusion is often measured within a specific geographical or political setting. Examination of diffusion processes attempt to explain the factors that facilitate or hinder this process. Diffusion research often provides a description of **who** adopts **when** relative to others in this geographical area. Initial research terms such as "innovator," "early adopter," or "laggard" have moved into everyday language to represent this relative relationship.

The Adoption Process

The adoption process, of primary concern here, is often categorized into a series of stages representing the decision process. The adoption model is a set of interrelated stages, from awareness and interest, through evaluation and trial, and finally to full adoption and/or adaption of a technology (Rogers, 1983). Rejection of a technology is possible anywhere in this process. An important distinction to bear in mind is that technologies are not just mechanical and chemical but can also be embedded in a cultural practice (intellectual) or economics (policy). These stages can be summarized as follows:

The Awareness-Information Stage

An individual must first either become **aware** of a problem and seek a solution, or a solution to a previous unknown problem is brought to the individual's attention. In the resource management area this implies one of two sequences. First, an individual can become aware of a problem such as excessive soil erosion or water pollution, and if the consequences of this problem are deemed to be significant, seek a solution. In this sequence resource management officials attempt to teach problem recognition and evaluation based on available technical or programmatic solutions. The emphasis is on recognition and salience of the problem.

In the second sequence, resource management officials promote practices or programs that are capable of addressing hitherto unrecognized problems. As often happens in the commercial sector, the practice or program is promoted as increasing the efficiency of the operation. In this latter sequence the farmer is expected to view the practice as the "solution" to a problem which has either been unrecognized or deemed insignificant in the past. The success of this latter sequence is also dependent on the degree of problem recognition and salience inculcated among the target audience. However, in this sequence the emphasis is on the practice or program with the

expectation the farmer will develop problem recognition.

Awareness of a practice or problem does not just happen. Awareness results from the communication of information regarding the practice or problem. The information can be communicated through both formal and informal channels. The clarity of the message in this communication process also varies. All this indicates that a major factor explaining the first stage of this adoption process is the nature of the communication network in which the farmer is linked. Resource management programs should theoretically be designing different communication efforts around the same problem or practice in order to link into these different information networks. Reliance on one communication technique (e.g., fact sheets, demonstrations, newsletters) will only contact a subset of the overall target population.

The Evaluation Stage

The individual will then **evaluate** the practice based on existing information and knowledge. Principal dimensions of this evaluation are relative advantage (cost/benefits) and compatibility to the operation. Other minor dimensions of evaluation are complexity, divisibility, and visibility of results.

Two sets of factors guide this evaluation process. First are the **objective attributes** of the practice or problem. That is, what objective analysis defines as the relative advantage or compatibility of a practice in a specific setting. For example, structural practices to control excessive erosion often have low relative advantage (high cost and little benefit over an extended period of time), and high incompatibility (structures inhibiting equipment operations). Or in the case of the objective attributes of a problem, erosion defined as excessive based on soil tolerance values may not be defined as excessive based on productivity damages. The adoption process is partially dependent on the outcome of this evaluation of the objective attributes of the problem or practice. Conservation officials and technicians rely largely on these objective attributes in building their persuasive messages.

There is, however, another factor that will influence this evaluation process. In large part evaluation is a series of "what if" mental exercises based on existing information as well as the cognitive abilities of the farmer. Incomplete or inaccurate information on the practice or problem will have a strong influence on the outcome of the evaluation process. Moreover, inadequacy or limitations in the ability to mentally "visualize" farm system impacts, agronomic requirements, or consequences will also influence this evaluation process. This implies that one cannot assume that the farmer is evaluating the practice or problem on the basis of perfect information or

assessment ability. It is on this factor, **perceived attributes** of the problem or practice, that most institutional arrangements are (should be) focused. One detects these perceived attributes in farmer testimonials or in the explanations given for non-adoption (e.g., "I can't afford it as it is too expensive," or "the problem really isn't that bad."). While technological developments attempt to change or alter the objective attributes of production techniques, resource management programs need to influence the perceived attributes through education, technical and financial assistance efforts. Both, however, have the same objective; to induce a positive evaluation of the resource management practice.

The Trial and Use Stage

The last stage in the adoption process refers to some degree of use of the practice in the farm operation. At this point the farmer has become aware of the practice and/or problem; has determined the practice or problem to be salient enough to spend additional effort seeking more information; was able to obtain adequate information to evaluate the compatibility and relative advantage of the practice; and the outcome of this evaluation was positive. The process through these stages can be detained or delayed if any of the conditions specified are missing or insufficient. If all these pre-conditions are met, then depending on the divisibility of the practice, trial on a small scale basis often occurs.

Trial represents the transition from a "will it work?" question to one of "can I make it work on my operation?" The potential adopter is still evaluating the practice at this stage, but in much more specific as opposed to general terms. Compatibility and economics are all being evaluated within a specific context of soils, climate, machinery, and labor among others.

In addition to this on-going evaluation process, the farmer must also make a decision in terms of applicable areas within the farm. The resource management practice may not be needed or appropriate for all areas of the farm. Deciding if the practice should be adopted is tempered with the need to decide on the extent of adoption.

If the trial decision is positive, then the practice will be adopted in applicable areas. However, even in the resource management area with its strict technical guidelines, it is rare for a practice to adopted without modification. The adoption decision is actually concurrent with on-going adaptation for increased compatibility and relative advantage. The extent the

practice can be modified or adapted to better fit specific farm conditions varies with the nature of the practice. The more flexible a practice, the greater the likelihood of a positive evaluation because of this adaptive potential. Moreover, changing markets, technology or even pest or climate cycles all predispose the farmer to seek flexible practices.

Obstacles to Adoption

Many of the studies of the adoption process tended to view all new technologies as "improved", bringing only benefits to the adopting farmer. These studies often approached the adoption process in a promotional vein akin to agricultural change agents such as extension agents or agribusiness sales persons. Recent critiques of, and research into, the adoption process are more cognizant of the negative impacts that can also accompany introductions of technological innovations. In addition, many social, political and resource constraints have been identified that farmers often face when adopting new practices.

Inability vs. Unwillingness to Adopt

The reasons for non-adoption can be placed into two general categories. A farmer is either unwilling or unable to adopt. These are not mutually exclusive categories in that a farmer can be able yet unwilling, willing yet unable or both. The reasons why farmers are unable or unwilling to adopt new technologies are often interrelated. Any one of these reasons could prevent adoption of a technology. The important point is that the farmer faced with any of these situations who chooses not to adopt is making a rational and correct decision. Risk plays a major role in the adoption process. It is important to keep in mind that from a behavioral perspective the perception of risk is real in its consequences. Coordinating all the activities and decisions necessary to operate a farm is full of risk. To ask a farmer to take on more risk by trying a new or unproven practice is often beyond what he or she is willing or able to accept.

Unable to Adopt. Reasons why producers are unable to adopt are numerous. Farmers may be unable because information is simply lacking or scarce. This appears to be especially true for site-specific information. There may be problems with the quality of the information as well. The costs of obtaining information about a technology may also cause a farmer not to adopt. Information is not free in that it requires time and effort to obtain. If these costs are too high a farmer may choose not to adopt.

Adoption rates may also suffer when the technology may be too complex in its operation or underlying principles. All things

being equal, the more complex a technology is, the less likely it will be adopted. Or, new practices can be simply too expensive for many farmers to adopt. Moreover, if a technology requires significant additional labor it may be out of reach for many farmers. Farmers are often unable to provide or hire additional labor, either because labor is too expensive or unavailable.

Another consideration is that incorporating a new practice into existing planning horizons may be problematic. There may be a mismatch between the two. The benefits of a technology may only accrue at a point beyond the current planning horizon.

When a technology is adopted it is usually accompanied by a support network which assists the farmer in its implementation. Equipment dealers, extension agents and other farmers are examples of supporting mechanisms. The absence of or restrictions in such support make beginning to use a new practice more difficult. If a farmer realizes he or she does not have the necessary managerial skills to successfully take advantage of a new practice, the decision not to adopt is correct.

A final and often overlooked reason why a farmer is unable to adopt is it may not be their decision to make. Bankers, landlords and other family members may be the ones who are actually the decision makers in a particular situation. If they are not convinced that a practice will work, the practice will not be adopted.

Unwilling to Adopt. Unwillingness to adopt can also arise for a number of reasons. A farmer may be unwilling to adopt because the information about the technology is inconsistent or simply conflicting. The information about a technology also may have poor applicability or relevance to a particular farm or farmer. Simply put the practice may not be "proven" as far as the farmer is concerned. The farmer may also be simply unaware of the practice or those promoting it. Another dimension of this constraint is when they may not have had the opportunity to learn about the basic economic or agronomic facts of the practice.

There may also exist conflicts between the current production goals and the new practice. The production goals can be influenced by government policy, family values and economics. If a practice does not accommodate these goals it will most likely not be used. Similarly, a promoted practice may be inappropriate to the physical setting. For example, many practices developed in the flat, fertile lands of the Midwest may not be appropriate to many other regions of the nation.

If a practice increases the chances of negative outcomes, perceived or actual, farmers will be reluctant to adopt. If, for example, a practice is more prone to the vagaries of the weather or markets it increases the risk of negative outcomes. A

critical question is whether the risk and uncertainty is inherent in the practice or due to inadequate information and support.

Finally, a farmer may simply be satisfied with traditional practices, especially those that have served well in the past. It is important to remember that many "traditional" farmers are still in business while many of their more "progressive" or "innovative" neighbors have long since gone out of business.

Demonstrations and Constraints to Adoption

The question of how well these constraints could be addressed by on-farm demonstration has revived little attention. This is especially true in light of the current interest in this method. It would not be expected for the on-farm demonstration method to address equally well all reasons for non-adoption. If on-farm demonstrations are being planned, used or evaluated, then understanding the strengths and weaknesses is required. Thinking about the relationship between on-farm demonstrations and constraints to adoption will assist in this regard. The previous discussion provides a starting point for systematically analyzing this relationship. Figure 2.2 lists the constraints to adoption outlined above and then hypothesizes as to the relative degree to which on-farm demonstration would be expected to address them. This scale does not take into consideration all the variables of location, persons involved, type of technology being promoted or target audience. As noted, all of these factors have a tremendous impact on the success of the demonstration effort.

Figure A.1

Ability of On-Farm Demonstration to Address Constraints to Adoption

SOURCE OF CONSTRAINT	NATURE OF CONSTRAINT	SUITABILITY[1] OF DEMONSTRATION RE CONSTRAINT
	Unable to Adopt	
Information	Lacking/scarce	Excellent
Information	Costs to obtain high	Excellent
Technology	Too complex	Fair
Technology	Too expensive	Poor
Farm Labor	Limited/unavailable	Poor
Technology	Planning horizon mismatch	Poor
Infrastructure	No support system	Good
Managerial Skill	Lacking/learning costs high	Good
Decision Control	Farmer not decision maker	Poor
	Unwilling to Adopt	
Information	Inconsistent/conflicting	Good
Information	Not applicable/relevant	Excellent
Technology	Goal conflicts	Poor
Technology	Unaware of technology	Fair
Technology	Inappropriate to setting	Poor
Technology	Increased negative outcomes	Fair
Technology	Satisfaction w/traditional	Fair

[1] Suitability is a subjective scale and ranges from poor, fair, good to excellent. The value on the scale is derived after assuming a well-designed demonstration regarding the dimensions discussed (i.e., accessibility, representative of farm/farmer, etc.).

The idea of specifying and knowing the target audience is central to a successful on-farm demonstration effort. A demonstration cannot be expected to be relevant to all farms in an area unless it is first determined there is significant homogeneity among these farms. This, however, is unlikely. Consequently, planning an on-farm demonstration first involves segmenting the general farm audience into relevant groups, and then designing the demonstration for one specific target audience.

The outlined dimensions of on-farm demonstrations all have impacts on the effectiveness of the demonstration. Yet these crucial aspects are rarely acknowledged, and too often on-farm demonstrations proceed along the path of least resistance. That is, past cooperators are often selected as demonstration farmers because this is most convenient to the organizing researchers or agency personnel.

Presumably on-farm demonstrations are chosen over -- or in addition to -- other knowledge dissemination methods (print or electronic media, meetings, farm-visits, etc.) because they are deemed to be more effective. Yet there has been little analysis on how to evaluate the effectiveness of a on-farm demonstration effort, or to compare the effectiveness of this approach to other dissemination techniques.

Farmers do not adopt new practices because they are unable, unwilling, or both. The many reasons behind farmers' inability or unwillingness to adopt are often rational and correct. Well-designed on-farm demonstrations have certain qualities that make them suited to address certain obstacles to adoption. Likewise they cannot be expected to address all the various constraints to adoption.

It is important to recognize that on-farm demonstrations are more than simply "demonstrating" a practice in a farm setting. If on-farm demonstrations are to play a larger role in the future, then it is essential that those involved begin to develop a basic understanding on how to design, conduct, and evaluate these demonstration efforts.

COMMUNICATION PROCESSES

The adoption research literature discussed in the previous section establishes a critical linkage between communication strategies and successful adoption programs. More specifically, different sources and types of information become more effective at different stages in the adoption process. For example, mass media have been found very effective in creating awareness of a new practice, but relatively ineffective in promoting evaluation of the practice.

Apart from the more direct information sharing that can occur through on-farm demonstrations, a comprehensive network of interpersonal and media channels is necessary to: (1) build initial awareness and interest in farmers of water quality issues and the existence of BMPs, (2) direct them to on-farm demonstrations and other sources as appropriate; (3) provide displays and materials available at on-farm demonstrations; (4) provide more permanent reference and instructional materials; and (5) reinforce through multiple sources the need to adopt appropriate BMPs. In effect, the projects can be readily viewed in the context of **public information campaigns.** The utility of this approach for project evaluation is that it brings to bear a substantial research literature on effectiveness of various communication source, message, channel, and audience-based characteristics in promoting adoption and related behaviors.

An implication for this project is that we must be capable of identifying sources of information and assistance by the stage of adoption for individual farmers. That is, we must be able to specify the relative importance and influence of these different sources as individuals move through or are retarded in the adoption process. Such data allow identifying situations where the information or assistance process is breaking down as individuals reach a certain stage in the adoption process but go no further. This type of information is needed to strengthen the content and delivery in these water quality demonstrations and in subsequent such programs. While the main intent of the projects is to influence farmers through the demonstration projects, many audience members may also be at least in part influenced through the array of media and interpersonal channels surrounding the demonstrations.

Another implication is the realization that farmers involved in these demonstration projects are not operating in an information vacuum. The local demonstration project will be only one of many different an often conflicting sources of information. A critical evaluation component is whether the demonstration project was designed with this fact in mind. That is, are the project communication efforts designed to complement rather than compete with these other information sources? In essence, the research must evaluate the extent the demonstration

project was designed as a public rather than private information campaign.

Producers' Communication Patterns

Although communication plays a vital role in agricultural production and marketing, we have little consistent or generalizable empirical evidence about farmers' information sources or how they use them. Literature reviews turn up only relatively small numbers of studies conducted about U.S. farmers and their communication patterns. Of these, many have been conducted with specific agronomic topics that restrict the ability to generalize to farmers' general information seeking patterns and their use of different channels.

Not only are these previous studies confined to specific areas of agricultural practices, but many are restricted geographically. Inconsistent, as well as small, sample sizes and responses rates limit the generalizability of these even more. Equally important, high variability is found in the operationalizations of key concepts. For example, the sources of information messages, e.g. USDA agencies, and the channels that convey them, e.g. television, are often confounded. And, such diverse constructs as information seeking by farmers and their exposure or attention to information are sometimes not suitably distinguished. Central concepts such as credibility tend to be unclearly measured, and/or lumped with measures of the utility or practically of an informational message. Also, much of the research has become dated with recent changes in the makeup of agricultural communication networks and the technologies they use (cf. Yarbrough, 1990). As a result, a significant portion of our evaluative data-gathering is devoted to determining the normative communication habits of farmers within each project's domain.

Nevertheless, some generalizations that can be offered here from past work include that agricultural magazines typically are the most mentioned source of information by farmers, with local and regional farm newspapers also a popular source when available. While most producers are apt to tune in to farm radio programs for news and market updates, televised farm programs don't fare nearly as well. Extension publications appear widely read for detailed information about specific practices, and score high in utility. Farmers do not seem to differ significantly from other publics in their use of general news and entertainment media.

Media sources obviously account for only a fraction of the information producers receive daily, with another large share of it coming from people they know or work with. Just how much and what kinds of information is more likely to come from interpersonal conversations is open to question, however. Potential sources are multiple and interactive. More commonly

listed ones include family, friends and partners; other farmers in the community; other farmers with similar interests outside the community; landlords; tenants; Extension, SCS, and allied agents, specialists and personnel on the Federal, state and county levels; commercial dealers, agents, sales representatives, field personnel, maintenance and repair personnel; cooperative representatives; processors; lenders and lending agents; and privately hired consultants. Ties with agricultural organizations and church and community groups may result in more formalized communication patterns as well. The most valued sources appear to be those with specialized information, e.g. Extension agents, university specialists, and in some regions, farm consultants. Other area farmers with shared interests tend to be highly valued as well.

Extension, SCS, and related organizations of course provide both interpersonal and mass media information. Much of the attention of farmers to print and broadcast media is likely tied at least in part to Extension's use of those channels in particular. Studies suggest farmers have far more contact with Extension though media than in person (Steele, 1979; Warner and Christenson, 1984; Fett et al., 1991).

Communication patterns among producers have also been found to vary considerably according to such characteristics as farm size and type, location, age, income, education, and ease of access to various channels.

Communication and Adoption

Some of the more productive work on agricultural communication focuses on the adoption and diffusion of new practices and technologies. This literature at the least has the benefit of being tied to an arching theoretical framework. A general hypothesis suggests that adoption by farmers is accelerated the more closely they are tied to information channels and networks. While most evidence seems to support this (cf. Rogers, 1983; Nowak, 1987), a dissident view is that economic factors, e.g. financial incentives, are more critical (e.g., Pampel and van Es, 1977). Indeed, studies reporting null effects for information orientations on adoption are markedly few (cf. Abd-Ella et al., 1981; Rogers, 1983; Albrecht and Ladewig; 1985).

Another prediction is that mass communication is relied upon more during awareness, information and evaluation stages of adoption, while interpersonal communication is used more for trial and adoption (Lionberger and Gwin, 1982; Rogers, 1983). However, actual findings on types of sources used by U.S. farmers in the adoption process indicate considerable variation depending on such factors as:

a. Adoption characteristics of the practice, e.g., complexity and profitability (Nowak, 1987; Thomas, 1990). A key issue here is how appropriate and suitable various communication sources are for different objective adoption characteristics, as well as ones perceived by farmers. Simpler low-risk practices may be conveyed though adoption by broadcast media, for example, while more complex long-term changes may require repeated interpersonal interaction, demonstration farms, and the like.

b. Availability and accessibility of information and channels (Mason, 1964; Yapa and Mayfield, 1978; Lionberger and Gwin, 1982; Rogers, 1983; Grunig et al., 1988; Thomas, 1990). Questions arise of how to increase the availability to more farmers of Extension, SCS, and related personnel and materials. Media dependency theory (Ball-Rokeach, 1985) predicts that choices of media vs. interpersonal communication are in part functions of social structure and conflict. A parallel issue involves a hypothesized "knowledge gap," by which the already more informed become even more so because of unequal distribution of or access to communication resources.

c. The utility, practicality and credibility of the information provided (Lionberger and Francis, 1969; Rogers, 1983). Research on adoption and diffusion, as well as more mainstream communication effects studies of the public overall, suggests that audience perceptions of how well various media and messages suit or "gratify" their needs is a critical variable in assessing communication impact (cf. Rosengren, Wenner and Palmgreen, 1985). This view encompasses audience members (in this case potential adopters) as more active and involved individuals seeking information to make appropriate decisions, rather than as passive targets being acted on by various change agents. A corollary is that farmers choose sources and channels on the basis of expectations about how those will serve their informational needs. Many of those expectations are based on previous experiences.

d. The appropriateness of timing of the information given the adoption stage (Mason, 1964; Rogers, 1983; Blum, 1990). Strategies for reaching the right farmer at the right or "teachable" moment with the right medium require more research attention. Blum, for example, found "worth" kinds of knowledge added to "how to" information to be important in the evaluation or persuasion stage.

e. Socio-economic and structural characteristics of producer and farm (Wilkening, 1950; Brown, 1981; Nowak, 1987; Anosike and Coughenour, 1990; Thomas et al., 1990). Indications appear of better educated and/or higher socio-economic strata and/or more organizationally integrated farmers having access to more information sources, especially more effortful or costly ones. Communication patterns have also been

found to vary by education, experience level, and size and type of operation.

f. Position of the farmers in the diffusion chain. (Lionberger and Francis, 1969; Brown, 1981; Thomas, 1990). The location of producers as early vs. late adopters and finer distinctions can set the context for what kinds media and message formats may be most appropriate and effective.

This evaluation study will address the above points in subsequent and more extensive data analyses. We turn below to some of the more descriptive research on overall producer media and interpersonal communication habits.

Public Communication Campaigns and Demonstrations

The problems identified above with respect to gaps in our knowledge of producer communication patterns can be alleviated in the present project by: (a) including in our evaluation plan formative research aimed at carefully delineating the communication orientations of farmers targeted by the demonstration projects; and (b) tracing farmers' use of demonstration project communications, and the impact of those on adoption.

These two approaches, however, are only part of a larger, more well-developed plan to sharpen our perceptions of this water quality BMP adoption process by viewing it in the context of public communication campaigns. This perspective permits the application of a wide body of research literature from the fields of communications, social psychology, marketing, and journalism. Although this literature has been applied only minimally to agricultural issues in the past, it holds significant potential for contribution to knowledge of adoption processes.

Public Communication Campaigns

Communication or information campaigns in general: (1) intend "to generate specific outcomes or effects (2) in a relatively large number of individuals, (3) usually within a specified period of time and (4) through an organized set of communication activities" (Rogers & Storey, 1987, p. 821). While public information campaigns share common interests in informing and influencing the citizenry, they often go about the job in widely varying ways depending upon the type of problem or issue being addressed and the specific campaign objectives (Paisley, 1989). Other factors affecting campaign strategies include the characteristics of their target audiences, and the time and money available for the effort (O'Keefe and Reid, 1990). Most such projects attempt to combine public information or media publicity

campaigns with community participation and training activities (Flora et al., 1989). Media tend to be more effective at building citizen awareness of an issue, while complex attitudinal or behavioral changes are apt to be accelerated by more direct forms of citizen contact and intervention (Rogers and Storey, 1987).

The development of successful informational and promotional programs in agricultural, environmental and other issue areas remains part art, part science. Even the more well-wrought efforts depend upon diverse and often scattershot approaches for reaching their audiences (Grunig, 1989; Salmon, 1989). Equally important, the programs are typically difficult to evaluate in terms of having achieved their goals. Commercial advertising or marketing campaigns can at least work with some kind of "bottom line" sales or response figure as a criterion, public campaigns often need to rely on more obtuse and distant indicators, e.g. numbers of deaths from heart disease, rate of traffic accidents, or physical indicators of environmental pollutants. The criteria for success or failure of these campaigns are often vague.

While more formal evaluations are increasing, they tend to be of low order scientific validity. Tight experimental controls are seldom used, largely because of the cost and complexity of implementing them in "naturalistic" field situations. Another difficulty in assessing even the most productive campaign evaluations is that the criteria for success are typically statistical tests of hypotheses, and little account is taken of the power of those tests in allowing generalizations concerning the "real world" impact of the messages. While it is helpful to know that attitudes toward topic "X" changed "significantly" following exposure to a campaign, the unanswered question that too often remains is how many individuals were affected, and to what extent. Such data are important to credible estimates of the cost or effort efficiency and effectiveness of campaigns.

Campaigns related to agricultural environmental issues pose special problems. Several of these are discussed in the previous section as barriers to adoption. Others fit under the umbrella of what Weinstein (1987) calls self-protective behavior. This construct encompasses anticipatory reactions to natural and occupational hazards, as well as more personal health and safety risks. Weinstein identifies the key predictor variables in precautionary behaviors as including beliefs about the probability and severity of the harm; the efficacy of a precautionary action; and the cost of taking action. Persuading people to increase such actions can be difficult, in part because of complex interactions among the above factors. Also, as Rogers and Storey (1987) note, programs advocating the adoption of behaviors to help "prevent" a possible unpleasant event in the future tend to be less successful than those offering more timely and obvious rewards.

Adding to the problem is that the salience of water quality, and perceived efficacy of protective behaviors, are apt to vary considerably across geographic, producer, and related characteristics. This heterogeneity calls for more careful -- and more effortful -- targeting of messages to specific subgroups for greater effect.

The Scope of Public Communication Campaigns and Programs

A multitude of communication campaigns and other promotional efforts have been developed over recent years aimed at influencing citizens' knowledge, attitudes and behaviors on a host of social and political issues. While all share common interests in informing and influencing the public, they often go about the job in widely diverse ways depending upon the type of problem or issue being addressed, the specific campaign objectives, the characteristics of their target audiences, and the time and money available for the effort. In general, however, most such programs attempt to combine public information or media publicity campaigns with community participation and training activities, much as is the case with the USDA demonstration projects. If just "getting the word out" is the main mission of the program, more reliance on media alone is called for. On the other hand, if goals include more complex attitudinal or behavioral changes, those are apt to be accelerated by more direct forms of citizen contact and intervention.

These campaigns are typically underfunded, at least in comparison to their immediate competitors for public attention: the multi-dimensional public relations and advertising campaigns of the private sector corporate world. They often depend a great deal on the work of volunteers and goodwill in-kind contributions by media and other business organizations. For example, a common component of programs involving media are public service advertisements, which are often produced with the assistance of local media and aired or displayed <u>gratis</u> by broadcast stations, newspapers and magazines.

Strategies for Increased Campaign Effectiveness

Nevertheless, some qualified generalizations can be made about certain strategies which appear to have had more success than others. In their review of the influences of public service advertising, O'Keefe and Reid (1990) comment on several factors that appear to make for more effective public-sector campaigns in general. Emphasized here are those that may be particularly relevant to producer adoption of water quality BMPs.

1. The more recent successful campaigns have incorporated

theoretical models of communication or persuasion into their development. Centering a campaign around a theoretical approach not only allows a broad base of knowledge to be brought to bear on the problem, but it also provides a guiding model or structure which can help order the sometimes complex and disorganized components of contemporary campaigns.

2. As an extension of the above points, successful campaigns are also more likely to have a clearly delineated set of operationalized campaign goals. Planners need to specify at a minimum what kind of impact goals are being aimed at, including the possible options of awareness, information gain, attitude change, motivation, and behavior change. Criteria should be established at the outset to allow subsequent judgement of the "success" or "failure" of a campaign.

The variables included under the rubric have been used as dependent variables in various persuasion-social influence models. To the extent that farmers are more competent in their adoption of the BMPs), they: (1) are more aware of or knowledgeable about how to perform; (2) hold more positive attitudes regarding their own abilities as well as the value of such actions; (3) feel more capable in acting effectively; (4) are motivated to act; and (5) engage in action. A sixth might be how well they can effectively evaluate their performance, adding something of a feedback loop.

3. The more influential campaigns have made extensive use of basic advertising and marketing planning in their design and execution. These include such rudimentary design elements as concept testing, focus group analysis, pretesting of campaign materials, and tracking the dissemination of campaign materials.

4. A corollary is that campaigns are likely to be more successful if their design takes into account not only existing audience awareness, attitudes and behavior, but their communication environments and patterns as well. A wealth of previous research on source, message and channel factors in influencing audiences provides a substantial resource for campaign planners intent upon matching messages to particular audiences.

Communication Campaigns and Demonstration Programs

Many of previously evaluated campaigns make a strong plea for the integration of more interpersonal or "hands-on" programs with more general media efforts. In the case of the USDA projects, it is actually the hands-on demonstration farm efforts driving the supplemental media programs, but the overall benefits

should be similar. The demonstrations should not only prompt social interaction and reinforcement, but also build the kinds of self-confidence that lead to control over one's environment, thereby setting the stage for learning and practicing new behaviors.

Heinzelmann (1988), writing of more urbanized neighborhood groups, indicates that citizen involvement in communication campaigns is more likely to occur if done in the context of an existing community network or organizations of citizens with a history of joint decision-making. Moreover, grassroots groups induce a sense of ownership or a stake in the task, thereby sustaining interest and participation over a longer time period.

Apart from that noted in the more comprehensive review of demonstration farms in Section 2, there has been little formative or summative evaluation of the impact of demonstrations. Related "field clinics" or workshops in areas such areas as diverse as public health (Flora et al., 1990) and crime prevention (Rosenbaum, 1986) have met with some quantifiable success, however. A key ingredient appears to be transferring to participants, apart from hands-on knowledge, a belief in the value of the practice to them and a sense of competence that they can successfully implement -- as well as evaluate -- it.

APPENDIX B

EVALUATION STUDY DESIGN

The basic goals of the research are to measure adoption across time by specified target audiences, account for practice demonstrations and other communication influences on this decision process, and then interpret the findings in such a way that it will enhance future technology transfer efforts. These three functions had to be accomplished in such a manner so as to be relevant to both individual demonstration sites and to national program efforts. Achieving these functions required an innovative research design.

The Quasi-Experimental Design Strategy

In studies of the effectiveness of government programs, it is important to determine whether the changes that occur in the treatment population are directly caused by the implementation of the program, or are due to some other factors. True experimental conditions (present in the scientific laboratory) provide an ideal opportunity to attribute causality to a single isolated source. A classic or true experimental research design is one where cause and effect relations are investigated by exposing one or more treatment groups to one or more randomly assigned treatment conditions and then comparing the results to one or more control groups not receiving the treatments. In pure evaluation studies, which must operate in the complex 'real world' where true experimental conditions are lacking, quasi-experimental designs can be employed.

A quasi-experimental design is one where not all the relevant variables can be manipulated or controlled through

random assignment of subjects to treatment or control groups. Instead researchers account for differences between the treatment and control groups through careful measurement of a wide range of relevant variables. Therefore, while quasi-experimental designs suffer from certain inherent limitations, that have been discussed elsewhere (Campbell and Stanley, 1963; Lipsey, 1990), careful attention to research design and analysis techniques can overcome many of these shortcomings (Isaac and Michael, 1981; Cook and Campbell, 1979).

The present research design allows for the tracing of economic, cultural, social and environmental changes within each site milieu that could contribute to patterns of awareness, knowledge, evaluation, and adoption of water quality BMPs. The relative impacts of these factors on the dependent variables will be examined within both the program sites, as well as within carefully selected comparison areas. This will allow inferences to be made concerning not only the influence of each type of factor independently or additively, but also interactively with demonstration project stimuli. Such analyses will subsequently allow more precise recommendations to be made about the types of demonstration materials deemed most effective across a range of economic, cultural, social and environmental situations.

The local project staff at each site identified the geographic boundaries of their demonstration sites. Farmers living in these areas will potentially be exposed to the demonstration program. The difficulty facing the evaluation team involves the attribution of changes in the use of water quality BMPs among the demonstration group farmers to the unique effects of this particular program. In the design of our study, we have attempted to account for the possible influence of non-treatment variables through **the use of a comparison group** and **careful measurement of other important exogenous variables.**

Initially, we have overseen (in conjunction with the project site coordinators, see below) the selection of comparison areas that are as similar as possible to the demonstration areas in each of the eight states. Comparison groups provide the analyst with an estimate of what would have happened to the demonstration population in the absence of the demonstration program. If we assume that the farmers in the control areas begin at roughly the same levels of awareness and concern about water quality problems, and are familiar with and use water quality BMPs to the same extent as the farmers in the treatment areas, we can look at the differential rates of change on each of these dimensions between demonstration and comparison groups as an estimate of the true "project effect".

In the ideal case, the **only** differences between the demonstration and comparison populations would be exposure to the program. Obviously, this is rarely the situation. As a result,

we intend to measure differences in initial conditions and background variables between the demonstration and comparison farms throughout the study period. This allows for statistical controls where exact control groups are absent or impractical.

At the analysis stage, we will incorporate information on the different characteristics of the demonstration and comparison groups in any statistical manipulation of the data. Using analysis of covariance and multiple regression methods, we should be able to distinguish the effects of the program from the confounding effects of other background variables (Cochran, 1983; Neter, Wasserman, and Kutner, 1989).

To this end, we are employing a variation of the Separate Sample Pretest/Posttest Control Group Design (see Campbell and Stanley, 1963:55-56). Essentially, this design involves several steps: (1) the identification of a demonstration and comparison population for each site; (2) the selection of a probability sample of farmers from within both demonstration and comparison populations; and (3) the random assignment of the sampled farmers to subgroups within both demonstration and comparison groups to check for any effect of prior measurement.

The variations on this basic model that we are employing are illustrated in Figure 4.2 below. In particular, we will be dividing the overall sample into five different subgroups (denoted Demonstration A_1, A_2, B, C, and D and Comparison A_1, A_2, B, C, and D, respectively). These subgroups will be sampled over four points in time (both groups A_1 and A_2 were included in the 1991-92 baseline survey). Because this design allows us to collect follow-up information from already tested groups, in addition to the data collected from previously untested groups, we will be able to isolate any effects of prior testing on the responses of repeat respondents.

The evaluation team will contact farmers in the demonstration and comparison areas at four points in time: an initial baseline survey in the winter of 1991-1992 (which has been completed); a set of follow-up and special issue surveys in 1992-93 and 1993-94; and a final survey (of all farms) at the conclusion of the program in January 1995. As mentioned above, the demonstration and comparison subgroups (A_1, A_2, B, C, and D) which enter the evaluation study at different time periods will be utilized to account for any instrument reactivity and/or learning effects due to the use of the survey instrument at an earlier period. To illustrate, note that farms in subgroup A_1 will continue to be surveyed at times 2 and 4, while farms in subgroup B will be surveyed for the first time in time 2, and will be included in the final survey at time 4.

Sampling

Based upon population estimates for each demonstration site, we used statistical tools to approximate the sample sizes necessary to makes comparisons among the various sites. Furthermore, because of suggests from USDA staff, we developed an elaborate and innovative geographic-based sampling methodology to identify first farm fields from aerial photos, and then their respective operators from ASCS 156EZ forms (or from other local sources when necessary). Figure B.1. depicts the basic principle of the sample selection process. This stratified systematic unaligned technique allows adequate representation of producers in demonstration and comparison areas, while avoiding many of the biases associated with using just available listings of farm operators.

BMP Selection Process

Given the extremely large and varied number of best management practices (BMPs) that could potentially be promoted at each of the eight USDA water quality demonstration sites, we were forced to develop a strategy for reducing the number of BMPs we would consider. Our selection strategy was driven by three main concerns: (1) **to ensure our ability to make national comparisons across sites** (either by selecting the same BMP at each site or finding BMPs that are similar on certain dimensions); (2) **to ensure that BMPs that we study will be actively promoted and are relevant at the local level**; and (3) **to determine key characteristics of BMPs that may explain patterns of adoption (or non-adoption).**

The selection process involved detailed queries and analyses assisted by the USDA, local project coordinators, and our University of Wisconsin Technical Review Group (Dr. Larry Bundy, Soil Science; Dr. Jeffrey Wyman, Entomology; Dr. Gary Bubenzer, Agricultural Engineering; Dr. Jess Gilbert, Rural Sociology; Dr. Lin Compton, Continuing and Adult Vocational Education; Dr. Fred Madison, Soil Science and the Wisconsin Geologic Natural History Survey; Dr. Richard Klemme, Agricultural Economics; and Jerry Griswold, USDA Soil Conservation Service).
After several iterations of analysis, four clusters of BMPs were delineated (Figure B.2.). The results of the cluster analysis were then sent to each state for confirmation and evaluation. The final list of project-by-project selections appears in Table 4.2.

Figure B.2.

BMP Clusters Selected For Producer Adoption Survey

GROUP A: BMPs that have Low Capital Requirements, High Managerial Requirements, and a High Potential for Divisibility.

1. Improved Pesticide Rates
2. Improved Pesticide Application Methods
3. Improved Pesticide Selection
4. Improved Pesticide Equipment Calibration
5. Nutrient Budgeting: Legume/Manure Credits
6. Nutrient Budgeting: Use of Soil or Plant Tests
7. IPM: Use of Economic Thresholds

GROUP B: BMPs that have High Capital Requirements, and a Low Potential for Divisibility.

1. Lagoon Upgrade
2. Manure Holding/Storage Facilities
3. Milk House Waste Management
4. Pesticide Storage Facility
5. Improved Pesticide Handling/Loading Site
6. Improved Septic Systems

GROUP C: BMPs that have Low Managerial Requirements.

1. Improved Animal Feeding/Watering Sites
2. Riparian Access Barriers/Streambank Fencing
3. Grassed Waterways
4. Pasture Improvement: Fencing
5. Wellhead Protection and Maintenance
6. Tailwater Wetlands Flow
7. Backsiphoning Protection

GROUP D: BMPs that have High Labor Requirements, High Managerial Requirements, and a High Potential for Divisibility.

1. Effective Irrigation Scheduling
2. Irrigation Management: Soil Moisture Testing
3. Split Applications of Nutrients
4. Integrated Pest Management: Pest Scouting
5. IPM: Monitoring for Pests
6. Non-Pesticide Alternatives: Use of Cultivation Systems

BMP Ranking By Local Importance

Figure B.3.

LISTING OF SELECTED BMPS BY STATES

BMP GROUPS	STATES							
	CA	FL	MD	MN	NC	NE	TX	WI
GROUP A: Low Capital, High Management, and High Potential Divisibility.								
1. Nutrient Budgeting: Manure Credits			X	X	X[6]			X
2. Nutrient Budgeting: Legume Crediting				X	X		X	X
3. Nutrient Budgeting: Use of Soil or Plant Tests		X[1]				LS[5]	X	
GROUP B: High Capital Requirements, and Low Potential for Divisibility.								
(None selected in final survey drafts)								
GROUP C: Low Managerial Requirements								
1. Riparian Access Management							X	
GROUP D: High Labor and Management, High Potential Divisibility.								
1. Split Application of Nutrients		X[2]	X	X	x[5]	X	X	X
2. Soil Moisture Testing/Watertable Monitoring		LS[3]						
3. Irrigation Scheduling		LS[3]		LS		LS		
4. Testing for Irrigation System Uniformity/Efficiency		LS[2]						
GROUP E: Local BMPs								
1. Tailwater Recirculation Systems	LS							
2. Gravity Tailwater Recapture System	LS							
3. Static Irrigation System	LS							
4. Float Valve Rice Boxes	LS							
5. Use of Fully Enclosed Seep-Irrigation System	LS[1]							
6. Poultry Composting					LS[4]			
7. Brush Management -- Prescribed Burning							LS	
8. Brush Management -- Mechanical Brush Control							LS	
9. Brush Management -- Reduced Herbicide Usage						LS		
10. Farmstead Assessment System								LS

KEY:

- X = chosen by us; central to project
- x = chosen by us; will receive some attention by project (not central)
- LS = Locally-selected BMP that we will use
- 1 = vegetable producers only
- 2 = citrus growers only
- 3 = both citrus and vegetable producers
- 4 = poultry producers only
- 5 = farmers only
- 6 = both poultry producers and farmers
- 7 = deep soil nitrate testing only

SURVEY IMPLEMENTATION

A number of options were available for collecting the needed information as part of the survey process. However, due to the assumptions on needed response rates used for calculating sample error and sizes, it was determined that a rigorous mail survey procedure was needed. We decided to use a version of the "Dillman Technique" or "Total Design Method" (Dillman, 1978), which provides an administrative framework and respondent contact strategy aimed at maximizing the quality and quantity of responses.

The design of a mail questionnaire is a critical issue relative to the validity of responses, the response rate, and the overall credibility of the project. Careful attention was paid to such considerations as personalized mailing, explaining the survey's relevance, guarantees of confidentiality, wording questions in familiar language, logical flow from question to question, eye-catching graphic design, and the like.

Concerns had been expressed by local and state project reviewers of draft instruments about "personal" questions related to farm finances, education, or family labor. We attempted to craft a delicate balance between what was specified in the evaluation contract, validated techniques reported in the research literature, and the concerns of local project personnel.

Segmentation involving variation in producer groups within demonstration areas, types of BMPs promoted, and comparison groups resulted in 26 versions of the questionnaire being needed (Figure A). The sequence of contacts involved a preliminary advance letter, the questionnaire with a personalized cover letter, and up to three more contacts, including a second questionnaire if necessary. The complexity of multiple sampling groups, lists, and mailings over time was eased somewhat by innovative use of an EXCEL software package to track all mailings and returns.

FIGURE B.4.
Sampling Sites -- Description

State	Description
CA1	California Demonstration Project, Colusa County
FL1	Florida Demonstration Project, Citrus Growers, Lake Manatee Watershed only
FL2	Florida Demonstration Project, Vegetable Growers, Lake Manatee Watershed only
FL3	Florida Demonstration Project, Citrus Growers, Manatee County (not Lake Manatee Watershed)
FL4	Florida Demonstration Project, Vegetable Growers, Manatee County (not Lake Manatee Watershed)
FL5	Florida Comparison Site, Citrus Growers, Palm Beach County
FL6	Florida Comparison Site, Vegetable Growers, Palm Beach County
MD1	Maryland Demonstration Project, Frederick County
MD2	Maryland Comparison Site, Frederick County
MN1	Minnesota Demonstration Project, Isanti County
MN2	Minnesota Demonstration Project, Sherburne County
MN3	Minnesota Comparison Site, Wadena County
NC1	North Carolina Demonstration Project, Farmers
NC2	North Carolina Demonstration Project, Poultry Producers
NC3	North Carolina HUA Site, Farmers
NC4	North Carolina HUA Site, Poultry Producers
NC5	North Carolina Comparison Site, Farmers
NC6	North Carolina Comparison Site, Poultry Producers
NE1	Nebraska Demonstration Project, Adams County
NE2	Nebraska Demonstration Project, York County
NE3	Nebraska Comparison Site, Gosper County
TX1	Texas Demonstration Project, Seco Creek Watershed
TX2	Texas Comparison Site, Frio River Watershed
WI1	Wisconsin Demonstration Project, East River Watershed
WI2	Wisconsin Comparison Site, East Winnebago County
WI3	Wisconsin Comparison Site, Bear Creek

Response Rates

Usable Survey Response Rate Calculation

Surveys returned blank or incompletely filled out are obviously not usable for data entry purposes. A coding system was built into EXCEL spreadsheet system which documented the reasons for blank surveys (e.g., no longer farming, wrong address, etc...). These reasons were accounted for when calculating response rates.

A formula was built to calculate response rates for usable surveys. The numerator of this formula is the total number of surveys returned minus the total number returned blank (whatever the reason). The denominator of the formula reflects the total number of surveys sent; minus the number of known non-operators, minus the number of known "duplicates" (identified by the owners/operators who referred us to people we had already sampled). This denominator more accurately reflects the sample population.

The resulting formula is:

$$\frac{\text{Total \# Returned - Total \# Blank}}{\text{Total \# Sent - Nonoperators - "Duplicates"}}$$

The following table outlines each state's usable survey response rate, following completion of nonrespondent interviews (in all states but Florida, where information is still outstanding). In nearly all cases, the rates are exceptionally high for mail surveys.

RESPONSE RATES

WATER QUALITY DEMONSTRATION PROJECTS
WAVE 1 SURVEY 1991-92

SAMPLE	*# SENT*	*# RET.*	*# NONOP.*	*BLANK/ REFUSALS*	*TOTAL BLANK*	*RESP. RATE*
CALIFORNIA						
Demo	114	93	13	15	28	64.36%
FLORIDA						
Demo-Citrus	26	18	3	0	3	65.22%
Demo-Veg.	5	2	0	0	0	40.00%
Manatee Cty - Citrus	66	43	1	5	6	56.92%
Manatee Cty - Veg.	27	15	4	0	4	47.83%
Comp. - Citrus	12	10	4	1	5	62.50%
Comp. - Veg.	18	10	1	0	1	52.94%
TOTAL FL	154	98	13	6	19	56.03%
MARYLAND						
Demo	118	93	20	5	25	69.39%
Comp	118	96	18	4	22	74.00%
TOTAL MD	236	189	38	9	47	71.72%
MINNESOTA						
Demo-Isanti Cty.	59	49	9	9	18	62.00%
Demo-Sherbourne Cty	65	52	14	6	20	62.75%
Comp-Wadena Cty.	103	89	37	4	41	72.73%
TOTAL MN	227	190	60	19	79	66.47%
NEBRASKA						
Demo - Adams Cty.	90	69	2	9	11	65.91%
Demo - York Cty.	111	86	3	6	9	71.30%
Comp - Gosper Cty.	41	34	5	0	5	80.56%
TOTAL NE	242	189	10	15	25	70.69%
N. CAROLINA						
Demo - Farmers	63	53	19	3	22	70.45%
Demo - Poultry	6	5	1	0	1	80.00%
HUA - Farmers	115	97	32	6	38	71.08%
HUA - Poultry	35	31	5	4	9	73.33%
Comp - Farmers	72	60	17	6	23	67.27%
Comp - Poultry	6	6	1	1	2	80.00%
TOTAL NC	297	252	75	20	95	70.72%
TEXAS						
Demo - Seco Crk.	97	84	25	10	35	68.06%
Comp - Frio River	114	92	33	8	41	62.96%
TOTAL TX	211	176	58	18	76	65.36%
WISCONSIN						
Demo-East River	128	110	16	11	27	74.11%
Comp-E. Winnebago	126	108	18	9	27	75.00%
Comp-Bear Creek	98	83	18	3	21	77.50%
TOTAL WI	352	301	52	23	75	75.33%
OVERALL						
TOTAL	1833	1488	319	125	444	68.96%
All states except Florida	include	nonrespondent	data.			

Nonrespondent Comparisons

A systematic sampling of producers included in the initial sampling frame but who did not respond was carried out, and with personal contacts and when possible interviews conducted with them. A preliminary analysis of these findings suggests no pattern of significant differences between those who participated in the study and those who did not. While there was a tendency for more respondents to report having had an instance of a water pollution problem on their own land, no indications were found that they regarded these problems as more serious than nonrespondents, or that they differed in awareness, evaluation, of use of BMPs.

COMMUNICATION ASSESSMENT

A necessary starting point for evaluating the impact of the eight state projects is to provide context by describing their organizational structure, dynamics of interagency cooperation and communication, and information and education (I & E) components and strategies.

The projects' I & E strategies are being tracked through site visits, long-distance telephone interviews, questionnaires and document collection
Up to this point, interviews have been conducted with state and local project personnel, including communication professionals, for each project. Questions of interest included: (1) interagency cooperation between ASCS, ES and SCS; (2) selection of cooperators and planning of demonstrations; (3) planning of I & E efforts; (4) USDA and state prioritization of I & E efforts supporting the demonstrations; and (5) use of controlled and public media for I & E efforts.

Each project's organizational structure will necessarily influence the way these demonstration projects are planned and implemented. The political bent and agendas of the three key agencies, their past working relationships and current leadership are all factors that will influence the direction and outcomes of these projects. To initially investigate the dynamics at work in each, the Nebraska Assessment Team assessed the management structure, professional compatibility, and communication and work environments of the demonstration projects. These assessments were performed during the projects' first year, with both formal and informal observational and anecdotal reports filed describing the outcomes of each visit. Certain insights of the Nebraska Assessment Team Study have been useful in our own analyses.

Another focus of this analysis are the I & E strategies project personnel intend to use (or are using) to educate their audiences about BMPs, in concert with the demonstration activities. Several questions are addressed here. For instance, how familiar are communication practitioners with their audience(s)? Is their audience aware, or concerned, that water quality has been identified as a problem in their area? What factors appear to stimulate awareness of water quality issues in the project area? Do practitioners know what media or information sources their audiences rely upon? How much priority do leaders put on planning and implementing a comprehensive I & E effort supporting the demonstration project?

Communication, although essential to the achievement of internal cohesion and external goals, is a slippery animal, difficult to harness and manage. Many people rely on their intuition in communication, in both personal and professional realms; however, its successful utilization as a tool is often bred of intent and purpose, as is noted in the previous section. One focus of the interviews with project leaders, therefore, was on the degree to which their I & E strategies are purposeful and planned. Differences between the various projects in terms of communication strategies are detailed in the full report.

Information Gathering

From January-July 1991 identified project personnel were telephoned. These people ranked from the state to local level, and they were interviewed at length about their responsibilities, the selection and scheduling of demonstrations, I & E strategies, and the information environment permeating project boundaries. Most interviews were conducted long-distance, and ranged in length from 15 minutes to one and one/half hours. In three instances site visits were made -- to the Wisconsin, Nebraska and Maryland projects -- to interview project personnel in day-long sessions. These site visits were illuminating -- helping us to learn more about the projects and providing a clearer picture of the agricultural territory and type of farmer these projects are targeting.

In addition to interviews, media and strategy surveys were distributed to communications practitioners. These were compiled from a variety of media source books. Media lists ranged over print, television, radio and cable outlets. In effect, these media surveys yield a "media map" of the demonstration/comparison areas. In addition, communications practitioners were requested to specify which type of communication strategies/outlets they intend to use most intensively in their projects -- whether controlled (e.g., brochures, fact sheets, etc.) or mediated.

Finally, after completing the initial interviews, project personnel were re-contacted periodically for updating about the projects and to learn more about demonstration tour/field day

schedules and publicity strategies. These follow-up calls will continue to be made on an ongoing basis.

Organizational factors being investigated regarding their bearing on I & E efforts include: (1) Project leadership, since within each project, it is not unusual to find that the attitudes, agendas and organizational style of the upper echelon influence what occurs among the lower ranks; (2) Interagency communication, in the sense that each agency has its own agenda and personality; (3) Teamwork among agencies, with the eight projects generally falling along a spectrum of cohesion in terms of teamwork and interagency communication/cooperation; (4) Office organization, since in some states offices have been set up separate from ES and SCS offices; in others, projects have set up primarily through the county ES offices, with county ES agents and SCS conservationists coordinating efforts out of their respective offices; (5) Roles and responsibilities, with each project having at least one person designated as project manager, acting as liaisons and facilitators between the state-level project directors, state-level communications specialists in ES and SCS, and local extension agents and district conservationists; (6) Follow-through on responsibilities, since on some projects, tension has resulted in cases where follow-through on responsibilities has been low or inconsistent.

APPENDIX C

STUDY METHODOLOGY PLANS FOR 1993-95

The 1993-95 data collection effort will include a series of sub-samples on selected issues arising from the analysis of the baseline data. Sub-samples in each of the demonstration projects and comparison areas will be scheduled for data collection in the winter of 1992-93 and again during the winter of 1993-94.

Consequently, instead of previously planned data collected during 1991-92, 1992-93 and 1995, there now will be annual data collection efforts (1991-92, 1992-93, 1993-94 and 1994-95) on original project objectives as well as selected issues. The major advantage of this revision is that it will increase project credibility by providing data from four points in time at equal intervals (91-92, 92-93, 93-94 and 94-95).

The longitundinal analyses will be carried out as discussed in Appendix B above and in the 1992 Background Working Report of this project.

The intervening "selected issue" samples will address significant changes in the plans of work of the projects, the emergence of special communication or other outreach efforts or the impact associated with new regulations, standards or other programs. Other special issues that may be sampled will be determined on the basis of the baseline data and consultation with national and local USDA personnel. For example, the baseline data could find a number of demonstration farmers in a stage of adoption where the research literature tells us that a certain form of information and assistance would be most effective. We could then measure the extent that these types of information and assistance are being provided. Other "adoption stage" issues could also be investigated as part of these special sub-samples.

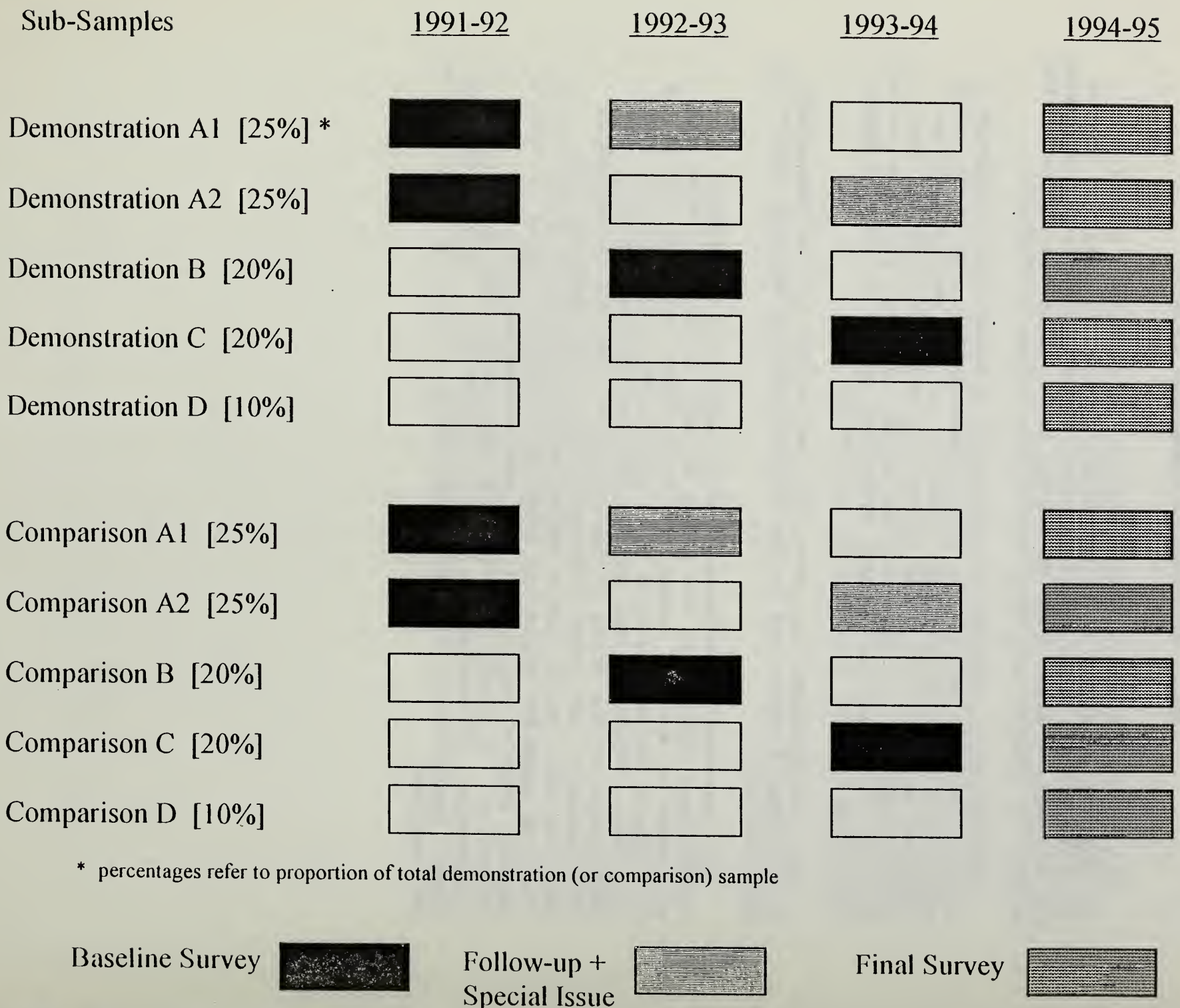

Sub-Samples
1991-92
1992-93
1993-94
1994-95
Demonstration A1 [25%] *
Demonstration A2 [25%]
Demonstration B [20%]
Demonstration C [20%]
Demonstration D [10%]
Comparison A1 [25%]
Comparison A2 [25%]
Comparison B [20%]
Comparison C [20%]
Comparison D [10%]
* percentages refer to proportion of total demonstration (or comparison) sample
Baseline Survey
Follow-up + Special Issue
Final Survey

Figure 1.

Figure 2.

LISTING OF SELECTED BMPS BY STATES

BMP GROUPS	STATES							
	CA	FL	MD	MN	NC	NE	TX	WI
GROUP A: Low Capital, High Management, and High Potential Divisibility.								
1. Nutrient Budgeting: Manure Credits			X	X	X[6]			X
2. Nutrient Budgeting: Legume Crediting				X	X		X	
X								
3. Nutrient Budgeting: Use of Soil or Plant Tests		X[1]				LS[5]	X	
GROUP B: High Capital Requirements, and Low Potential for Divisibility.								
(None selected in final survey drafts)								
GROUP C: Low Managerial Requirements								
1. Riparian Access Management							X	
GROUP D: High Labor and Management, High Potential Divisibility.								
1. Split Application of Nutrients		X[2]	X	X	x[5]	X	X	X
2. Soil Moisture Testing/Watertable Monitoring		LS[3]						
3. Irrigation Scheduling		LS[3]		LS		LS		
4. Testing for Irrigation System Uniformity/Efficiency		LS[2]						
GROUP E: Local BMPs								
1. Tailwater Recirculation Systems	LS							
2. Gravity Tailwater Recapture System	LS							
3. Static Irrigation System	LS							
4. Float Valve Rice Boxes	LS							
5. Use of Fully Enclosed Seep-Irrigation System		LS[1]						
6. Poultry Composting					LS[4]			
7. Brush Management -- Prescribed Burning							LS	
8. Brush Management -- Mechanical Brush Control							LS	
9. Brush Management -- Reduced Herbicide Usage						LS		
10. Farmstead Assessment System								LS

KEY:

- X = chosen by us; central to project
- x = chosen by us; will receive some attention by project (not central)
- LS = Locally-selected BMP that we will use
- 1 = vegetable producers only
- 2 = citrus growers only
- 3 = both citrus and vegetable producers
- 4 = poultry producers only
- 5 = farmers only
- 6 = both poultry producers and farmers
- 7 = deep soil nitrate testing only

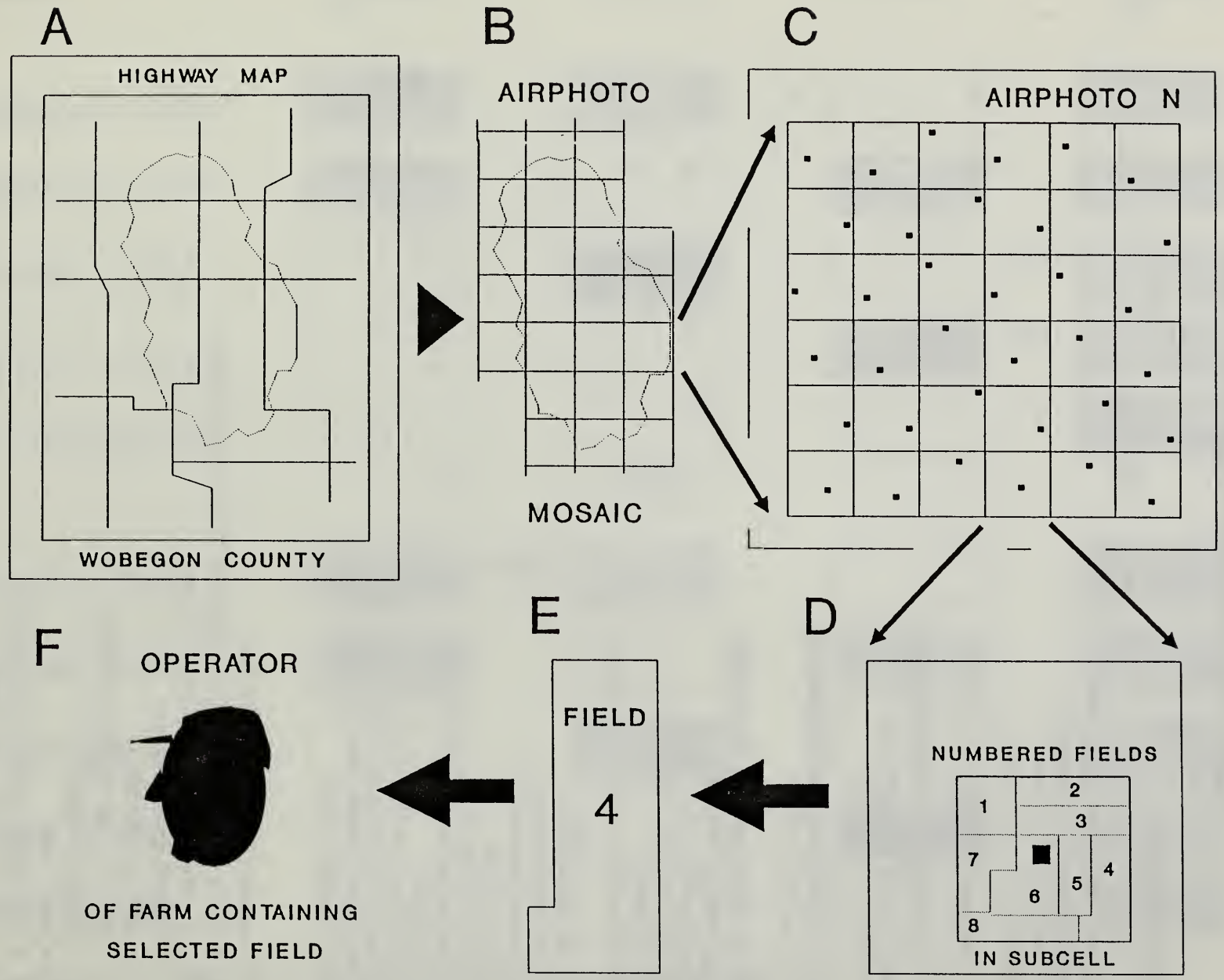

A
HIGHWAY MAP
WOBEGON COUNTY
B
AIRPHOTO
MOSAIC
C
AIRPHOTO N
D
NUMBERED FIELDS
1
2
3
4
5
6
7
8
IN SUBCELL
E
FIELD
4
F
OPERATOR
OF FARM CONTAINING
SELECTED FIELD

Figure 3.

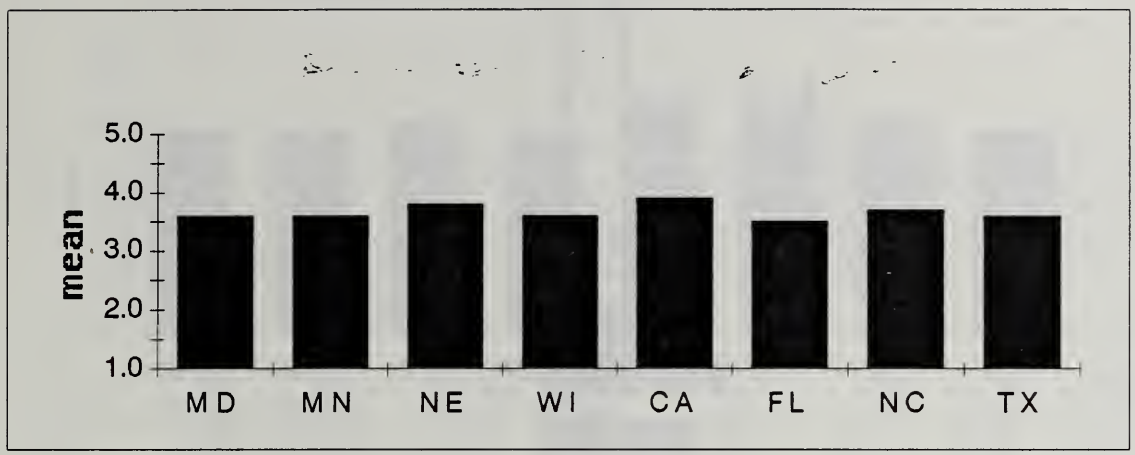


Figure 4. Exposure to water quality information

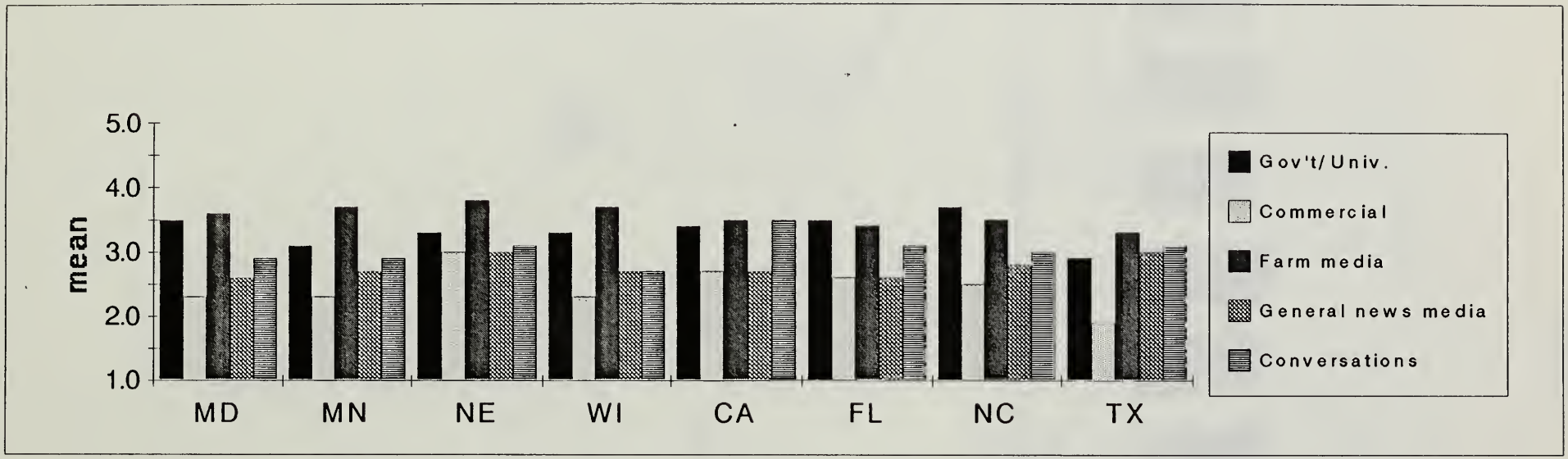
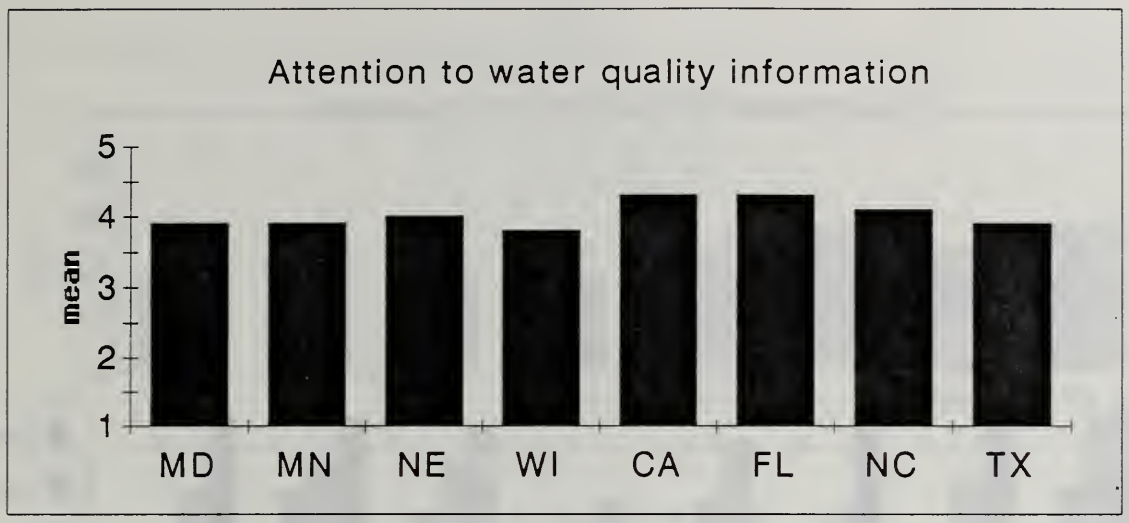
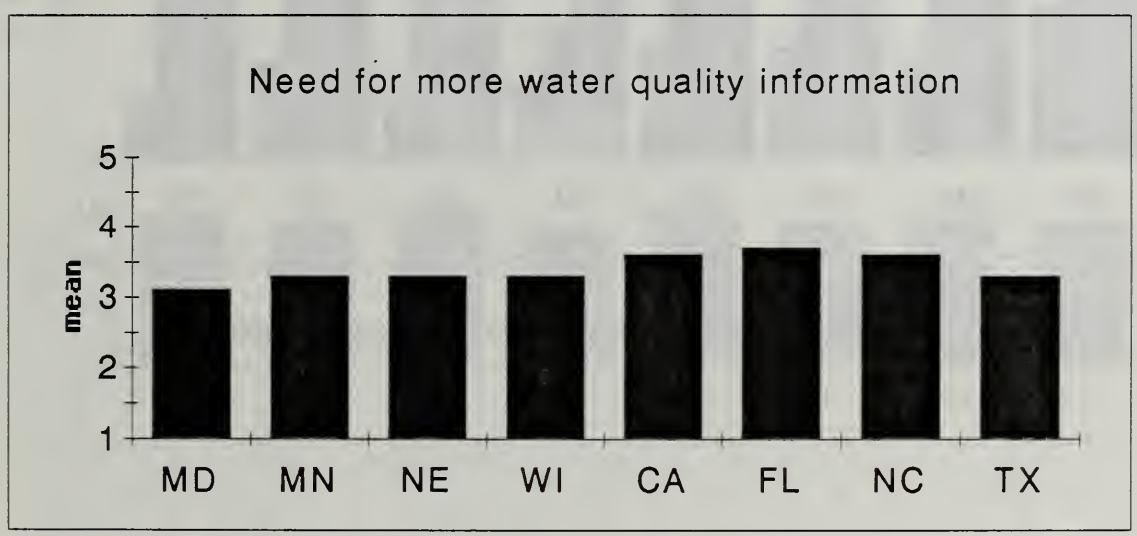


Figure 5. Water quality information sources





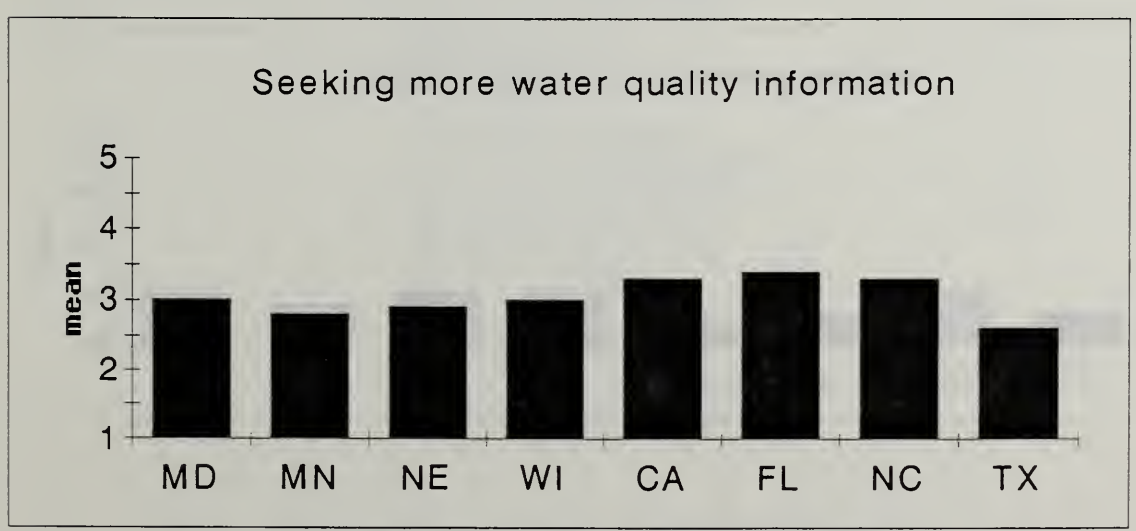


Figure 6. Patterns of water quality information use

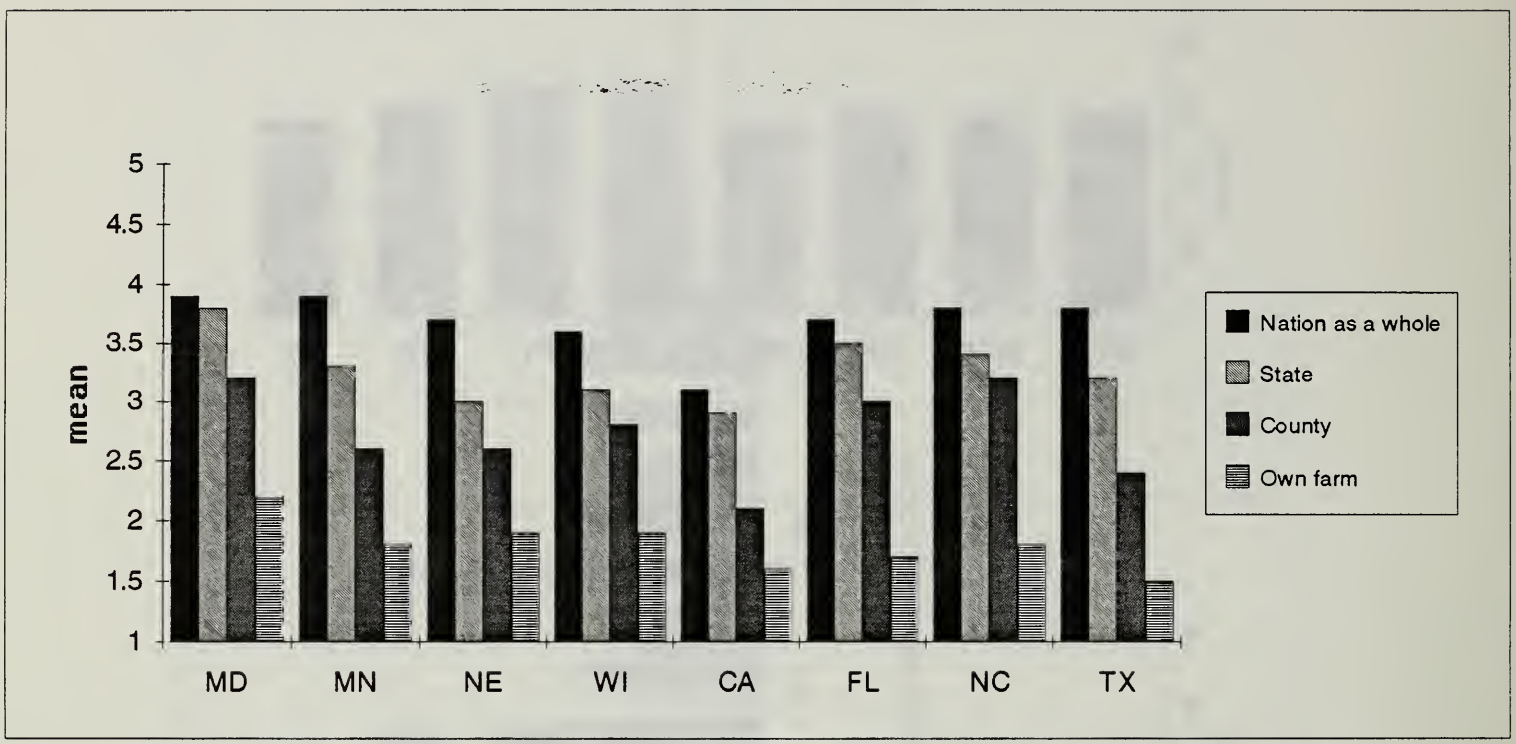
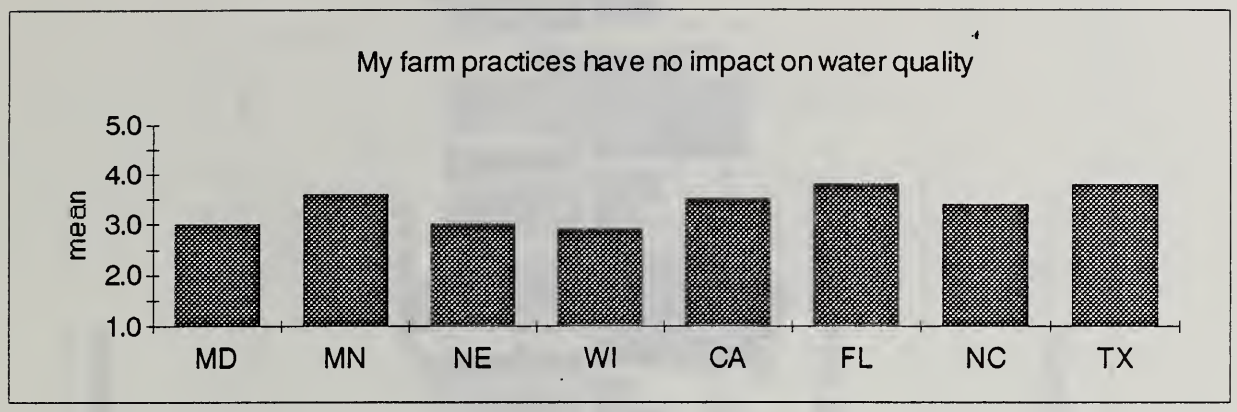
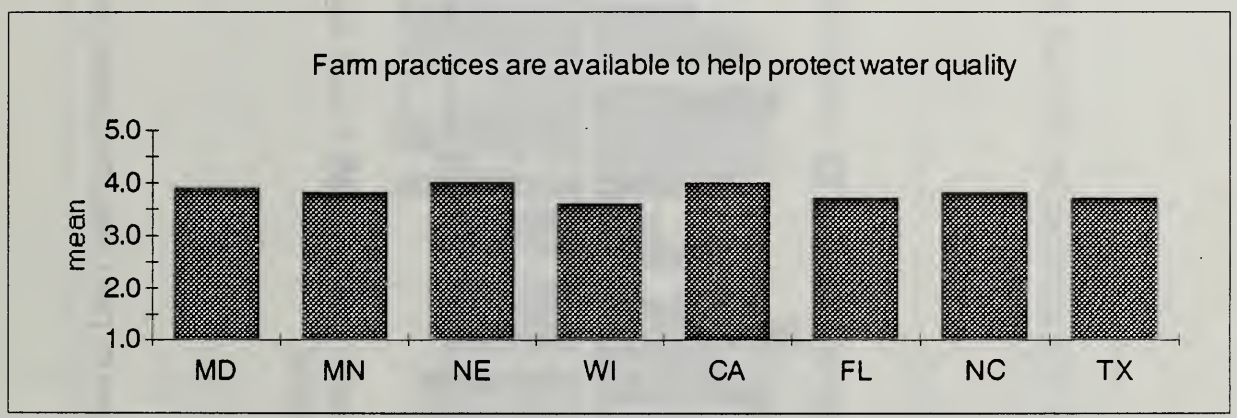


Figure 7. Perceptions of water pollution problems





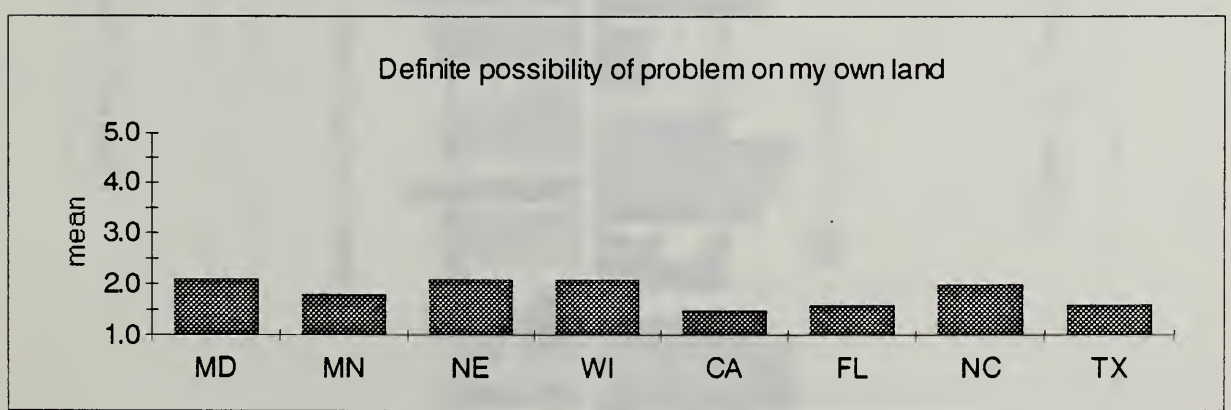


Figure 8. Attitudes toward water quality

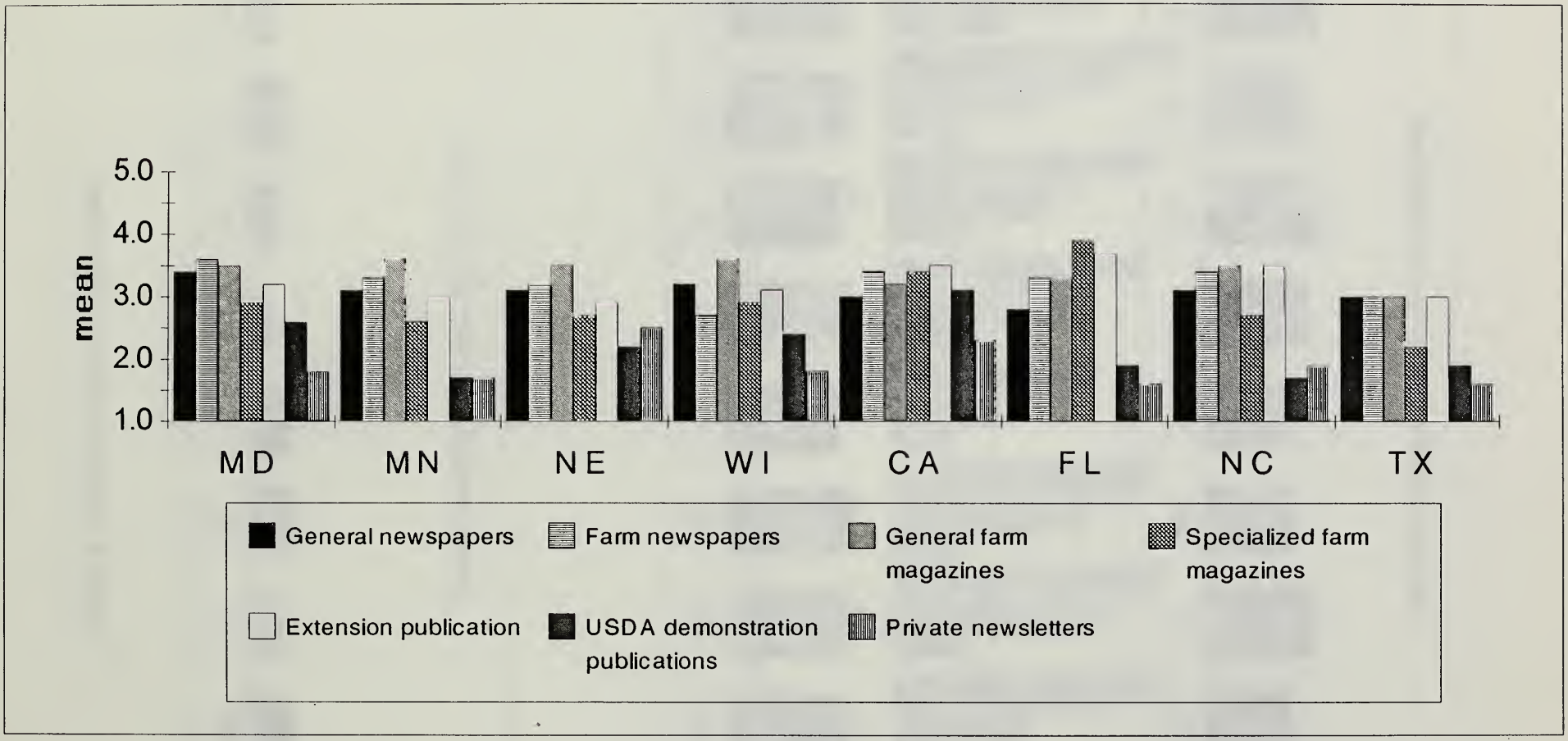


Figure 9. Frequency of use of print media sources for farm decisions

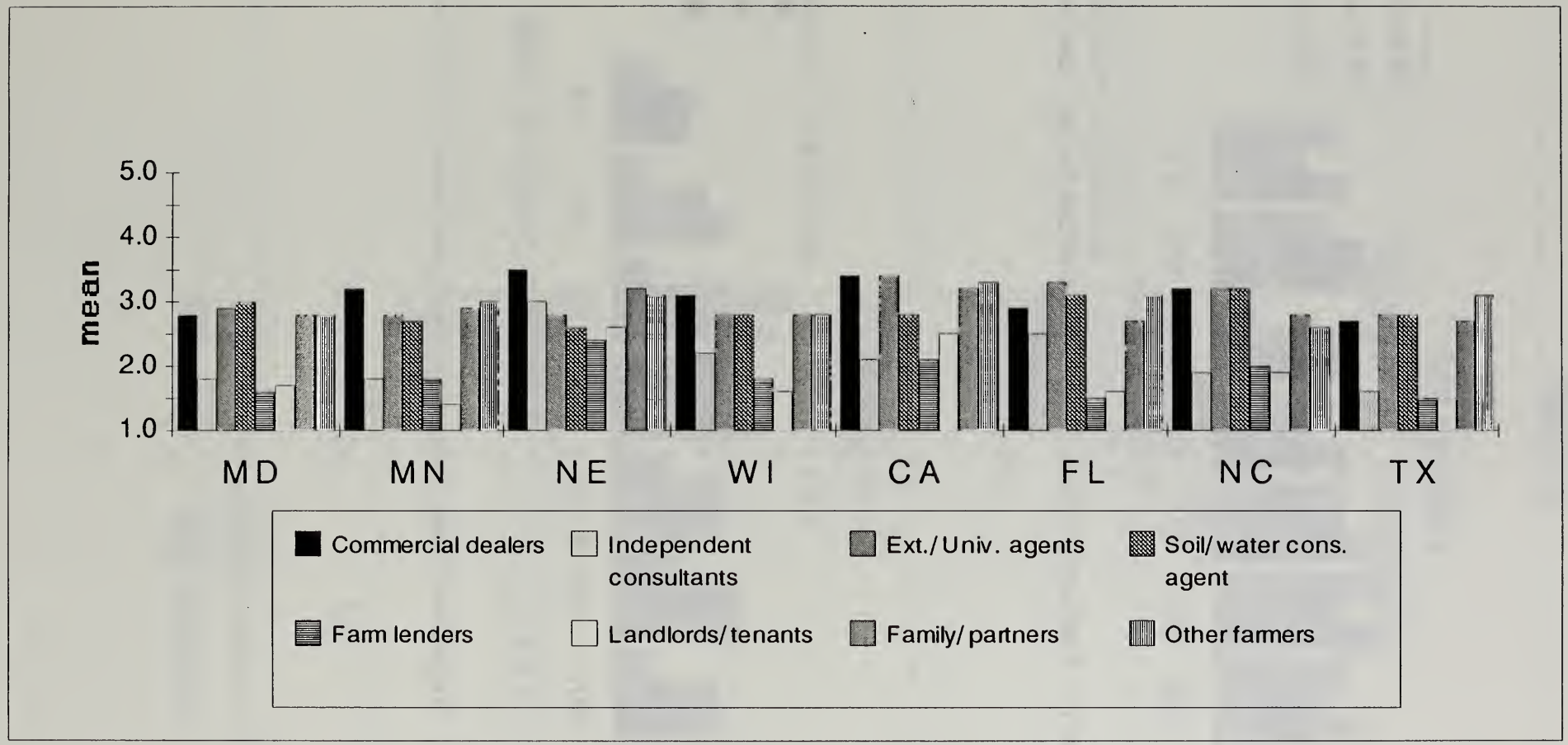


Figure 10. Frequency of use of interpersonal sources for farm decisions

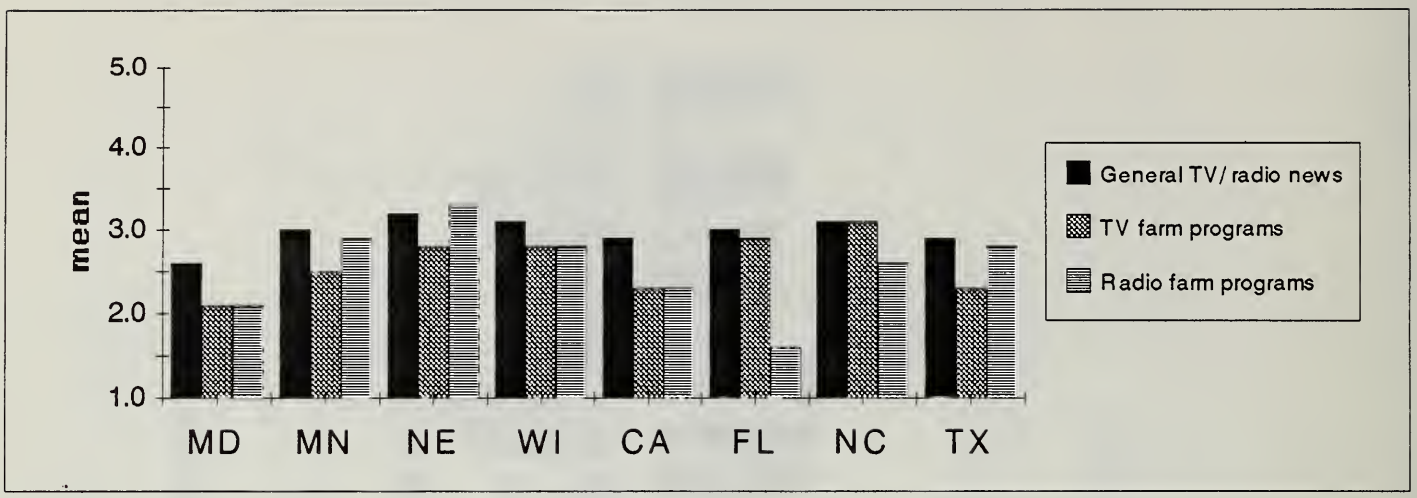


Figure 11. Frequency of use of electronic sources for farm decisions

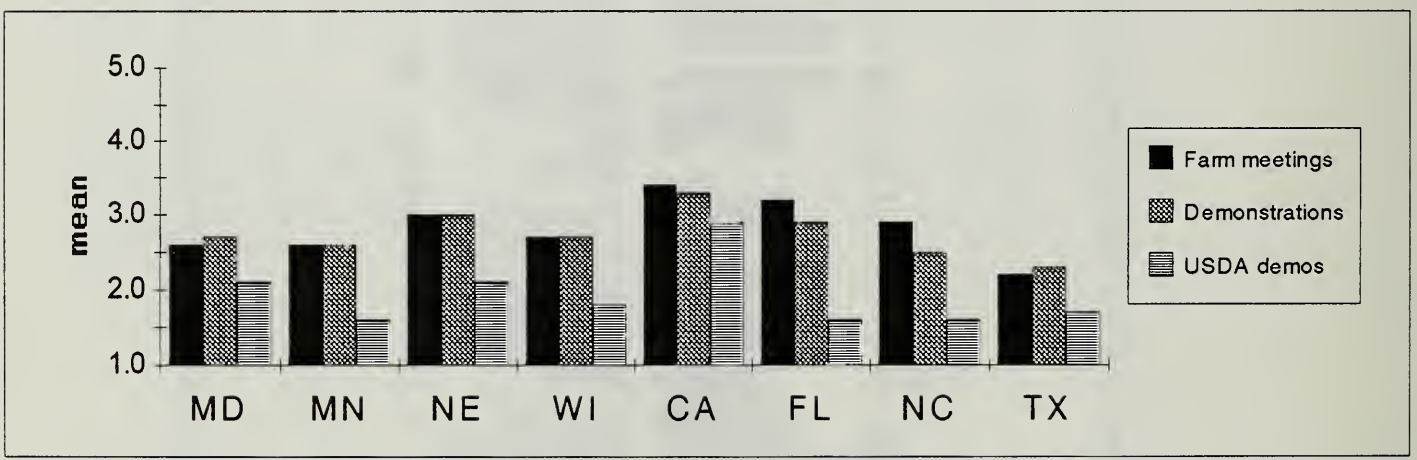


Figure 12. Frequency of use of meetings, demonstrations for farm decisions

Figure 13.

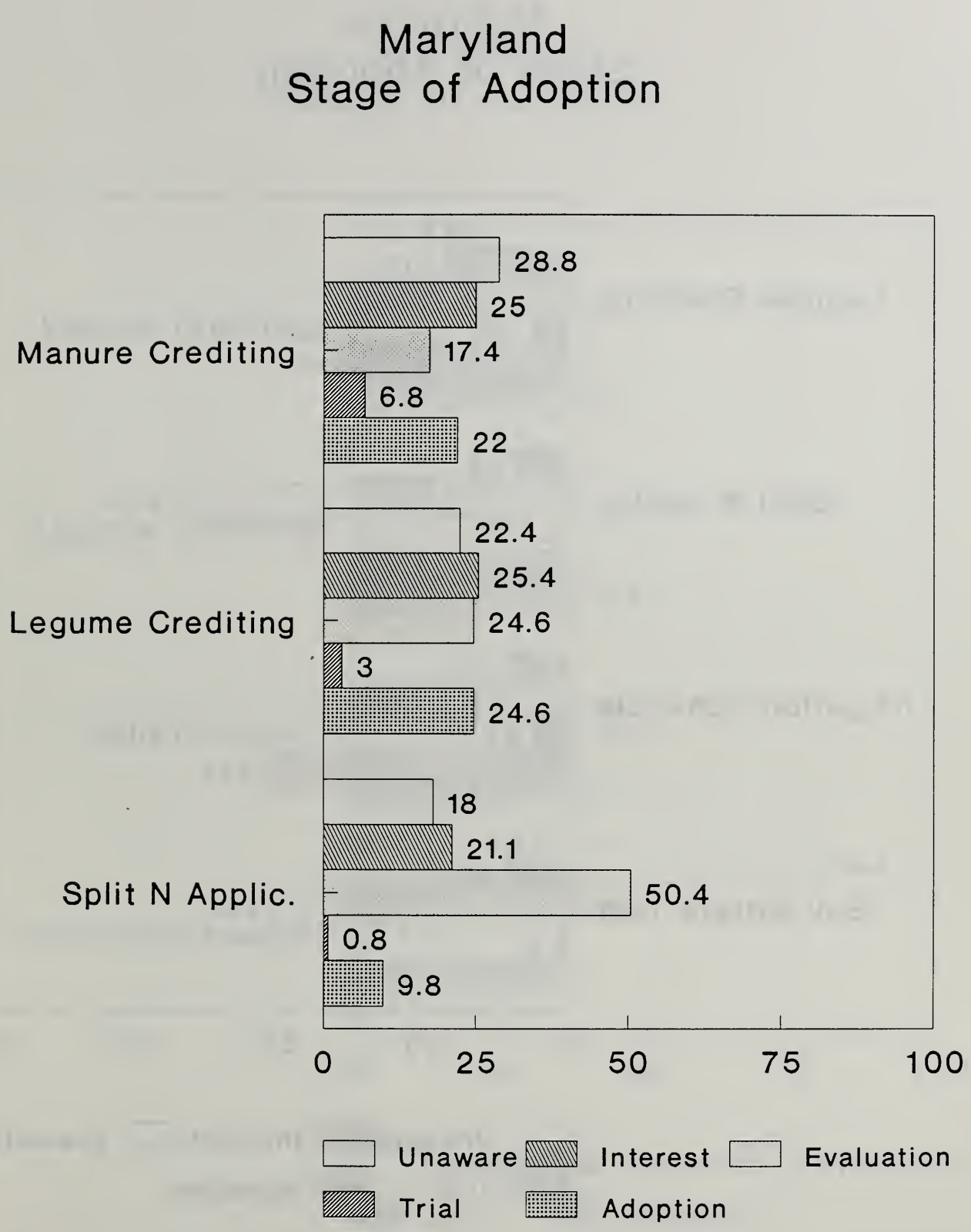

Maryland
Stage of Adoption
Manure Crediting
28.8
25
17.4
6.8
22
Legume Crediting
22.4
25.4
24.6
3
24.6
Split N Applic.
18
21.1
50.4
0.8
9.8
0
25
50
75
100
Unaware
Interest
Evaluation
Trial
Adoption

Figure 14.

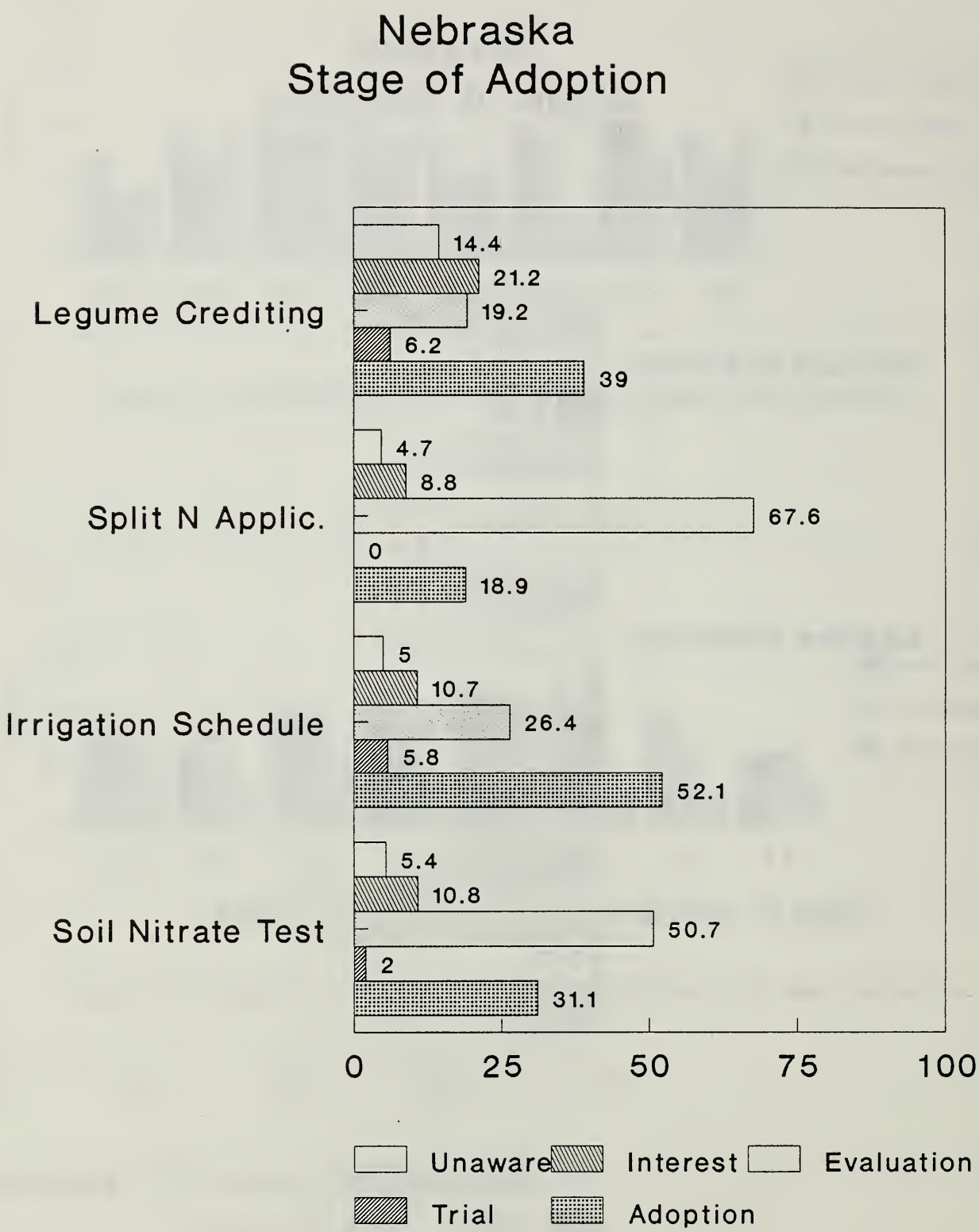

Nebraska
Stage of Adoption
Legume Crediting
14.4
21.2
19.2
6.2
39
Split N Applic.
4.7
8.8
67.6
0
18.9
Irrigation Schedule
5
10.7
26.4
5.8
52.1
Soil Nitrate Test
5.4
10.8
50.7
2
31.1
0
25
50
75
100
Unaware
Interest
Evaluation
Trial
Adoption

Figure 15.

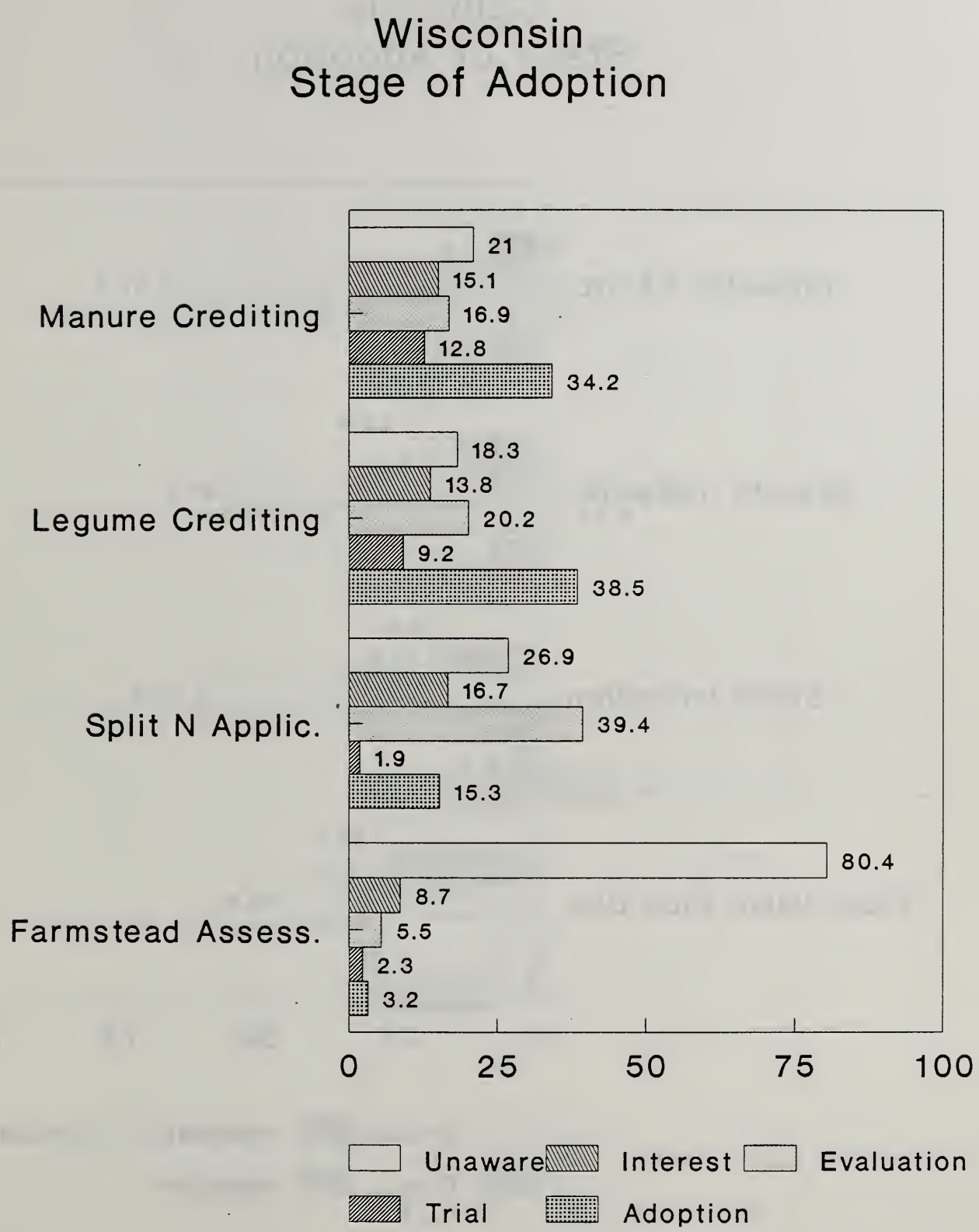

Wisconsin
Stage of Adoption
Manure Crediting
21
15.1
16.9
12.8
34.2
Legume Crediting
18.3
13.8
20.2
9.2
38.5
Split N Applic.
26.9
16.7
39.4
1.9
15.3
Farmstead Assess.
80.4
8.7
5.5
2.3
3.2
0
25
50
75
100
Unaware
Interest
Evaluation
Trial
Adoption

Figure 16.

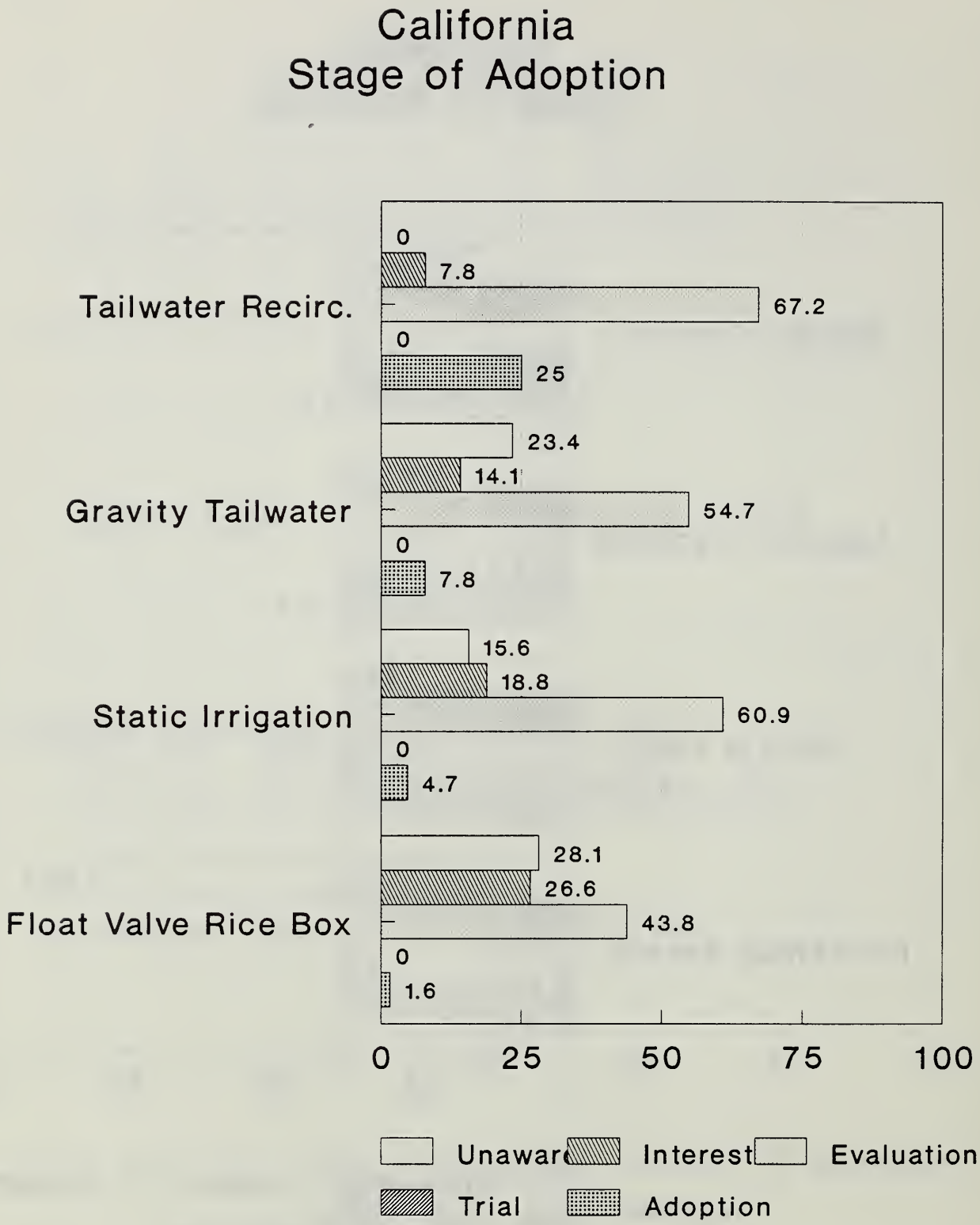

California
Stage of Adoption
Tailwater Recirc.
0
7.8
67.2
0
25
Gravity Tailwater
23.4
14.1
54.7
0
7.8
Static Irrigation
15.6
18.8
60.9
0
4.7
Float Valve Rice Box
28.1
26.6
43.8
0
1.6
0
25
50
75
100
Unaware
Interest
Evaluation
Trial
Adoption

Figure 17.

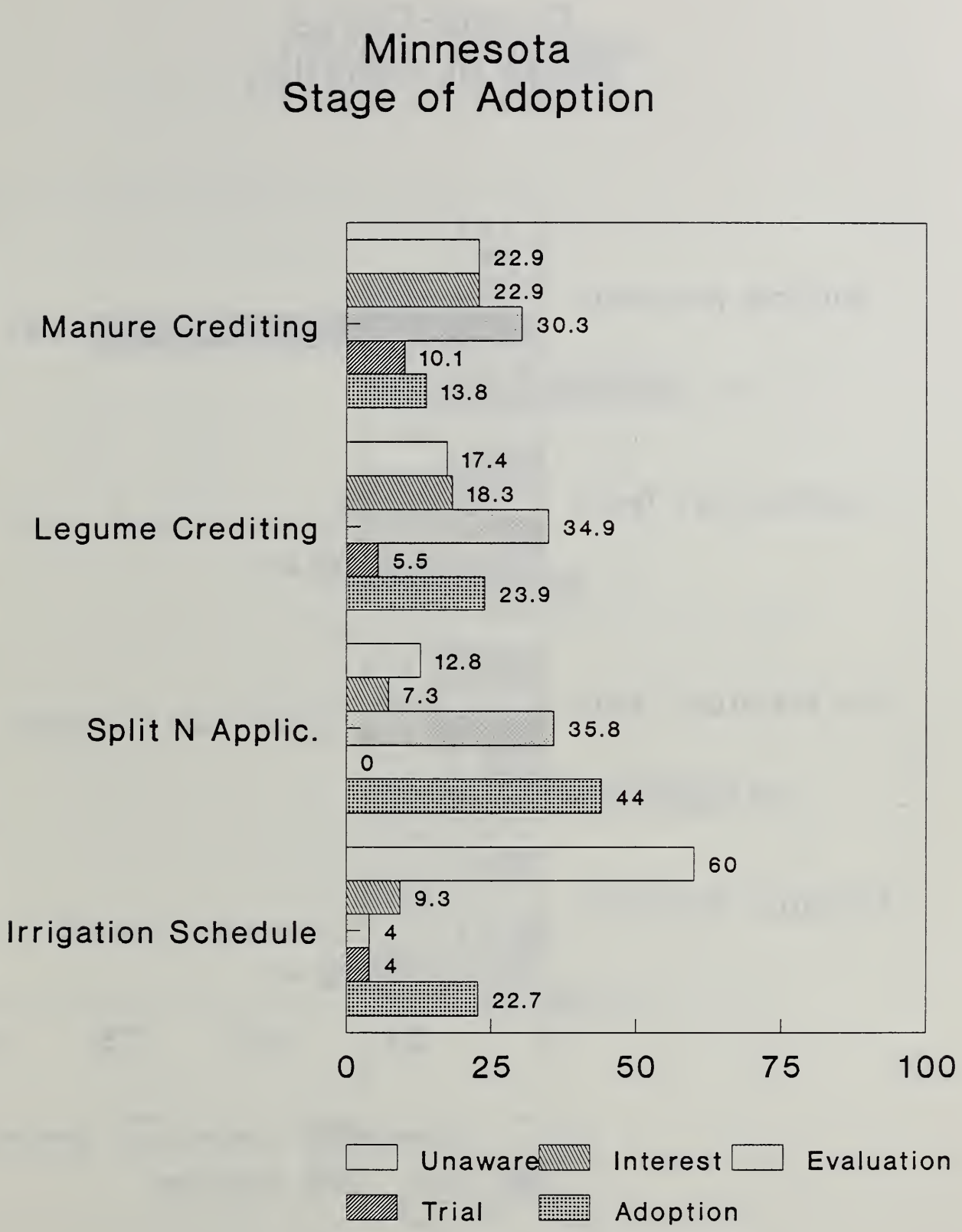

Minnesota
Stage of Adoption
Manure Crediting
22.9
22.9
30.3
10.1
13.8
Legume Crediting
17.4
18.3
34.9
5.5
23.9
Split N Applic.
12.8
7.3
35.8
0
44
Irrigation Schedule
60
9.3
4
4
22.7
0
25
50
75
100
Unaware
Interest
Evaluation
Trial
Adoption

Figure 18.

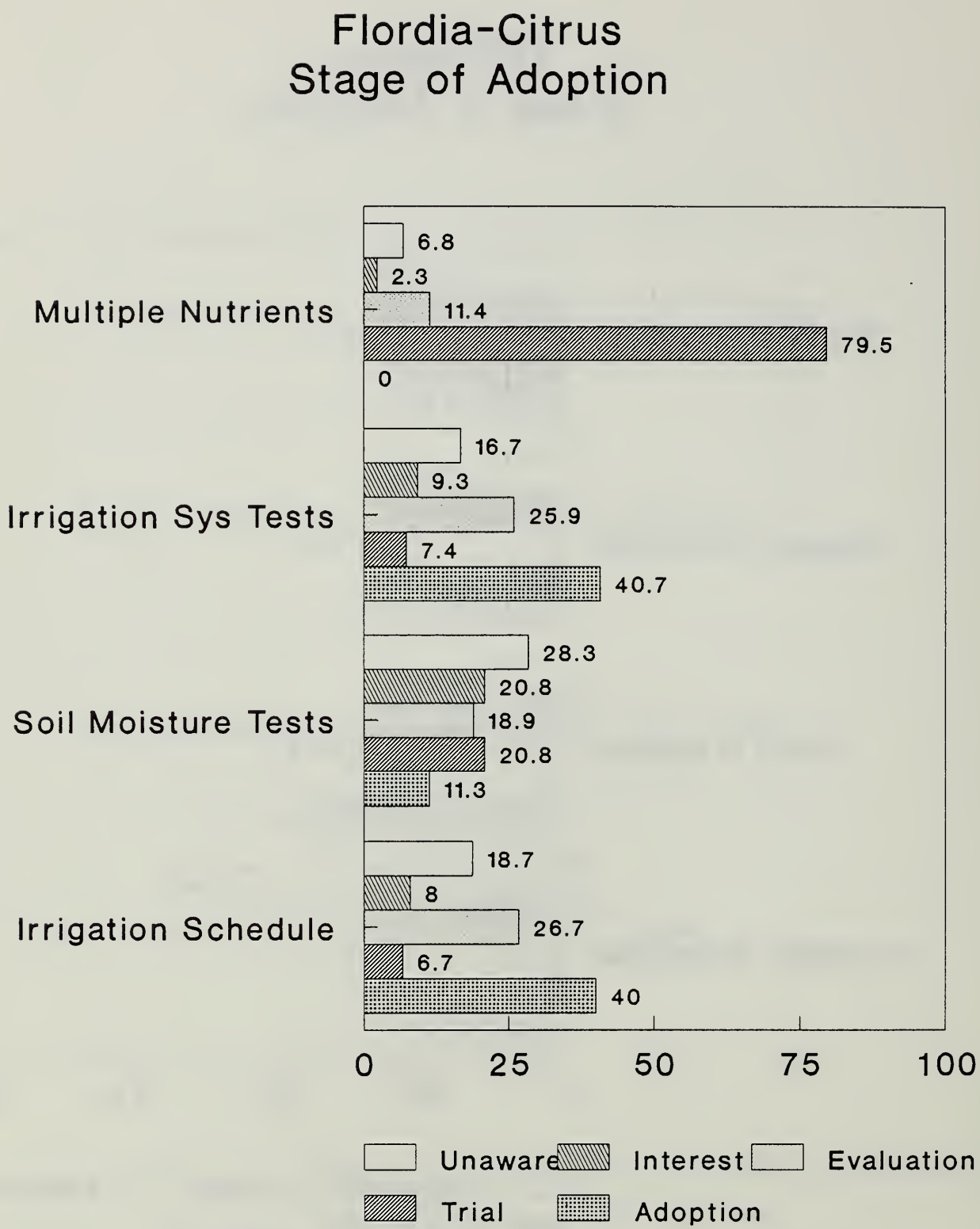

Flordia-Citrus
Stage of Adoption
Multiple Nutrients
6.8
2.3
11.4
79.5
0
Irrigation Sys Tests
16.7
9.3
25.9
7.4
40.7
Soil Moisture Tests
28.3
20.8
18.9
20.8
11.3
Irrigation Schedule
18.7
8
26.7
6.7
40
0
25
50
75
100
Unaware
Interest
Evaluation
Trial
Adoption

Figure 19.

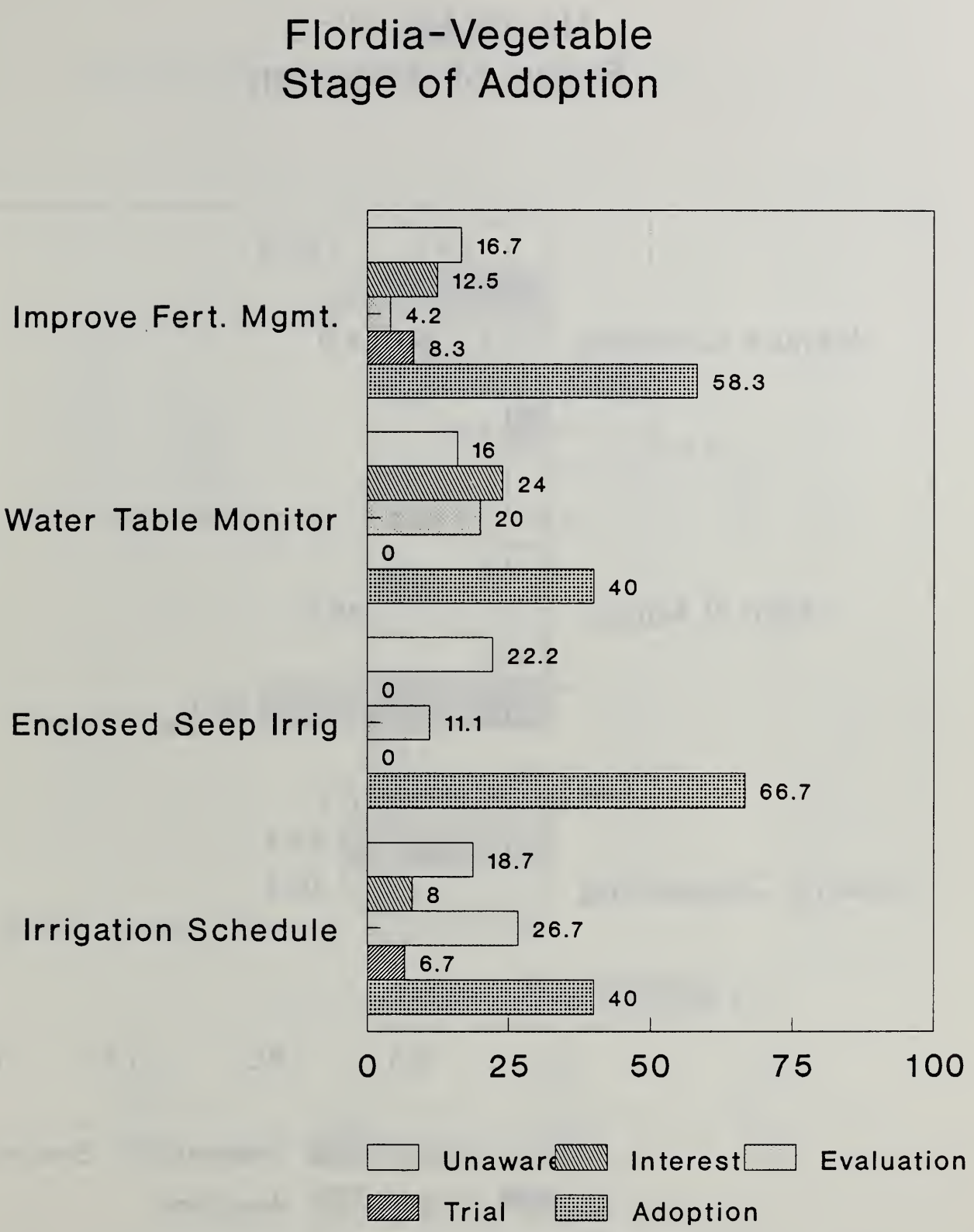

Flordia-Vegetable
Stage of Adoption
Improve Fert. Mgmt.
16.7
12.5
4.2
8.3
58.3
Water Table Monitor
16
24
20
0
40
Enclosed Seep Irrig
22.2
0
11.1
0
66.7
Irrigation Schedule
18.7
8
26.7
6.7
40
0
25
50
75
100
Unaware
Interest
Evaluation
Trial
Adoption

Figure 20.

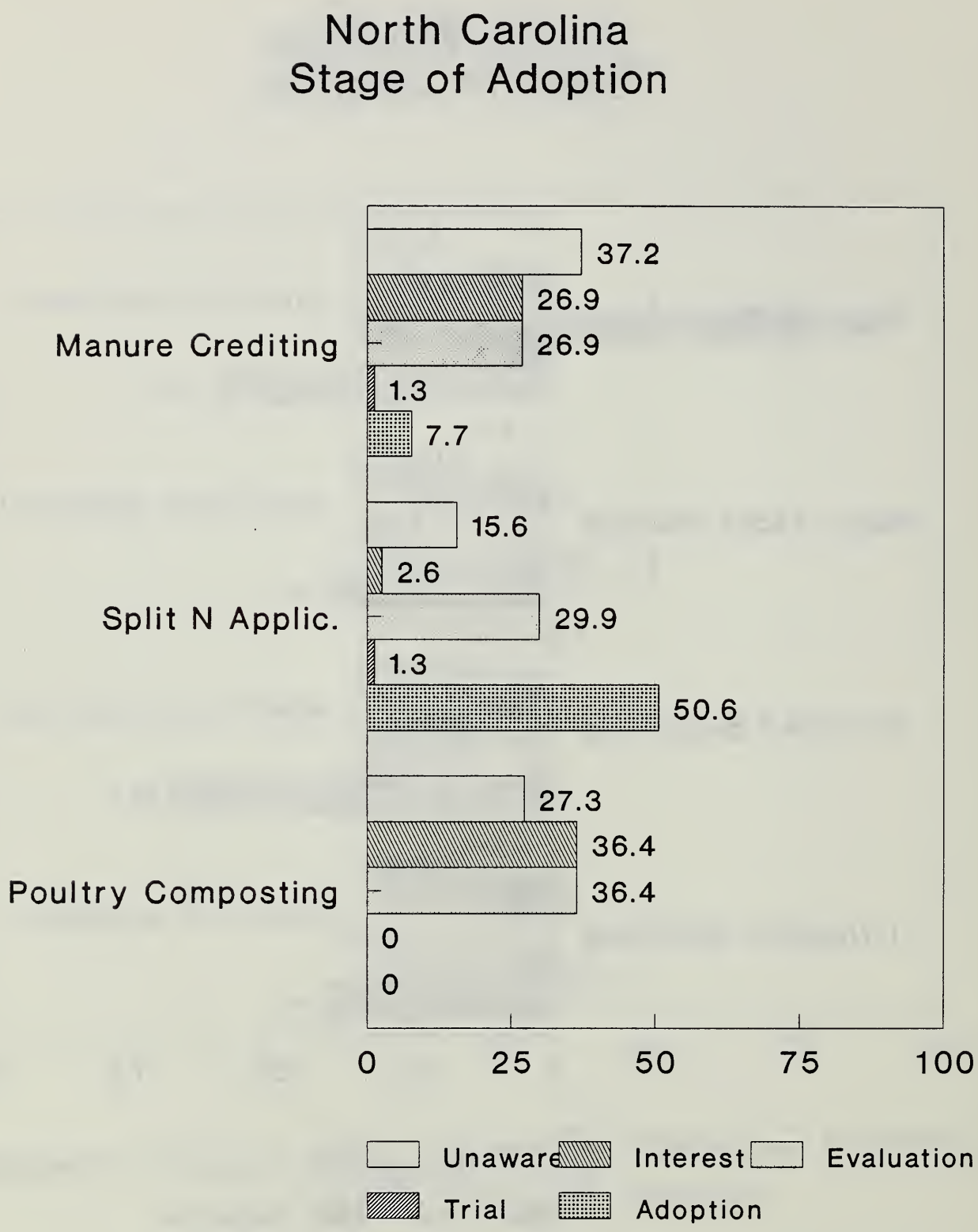

North Carolina
Stage of Adoption
Manure Crediting
37.2
26.9
26.9
1.3
7.7
Split N Applic.
15.6
2.6
29.9
1.3
50.6
Poultry Composting
27.3
36.4
36.4
0
0
0
25
50
75
100
Unaware
Interest
Evaluation
Trial
Adoption

Figure 21.

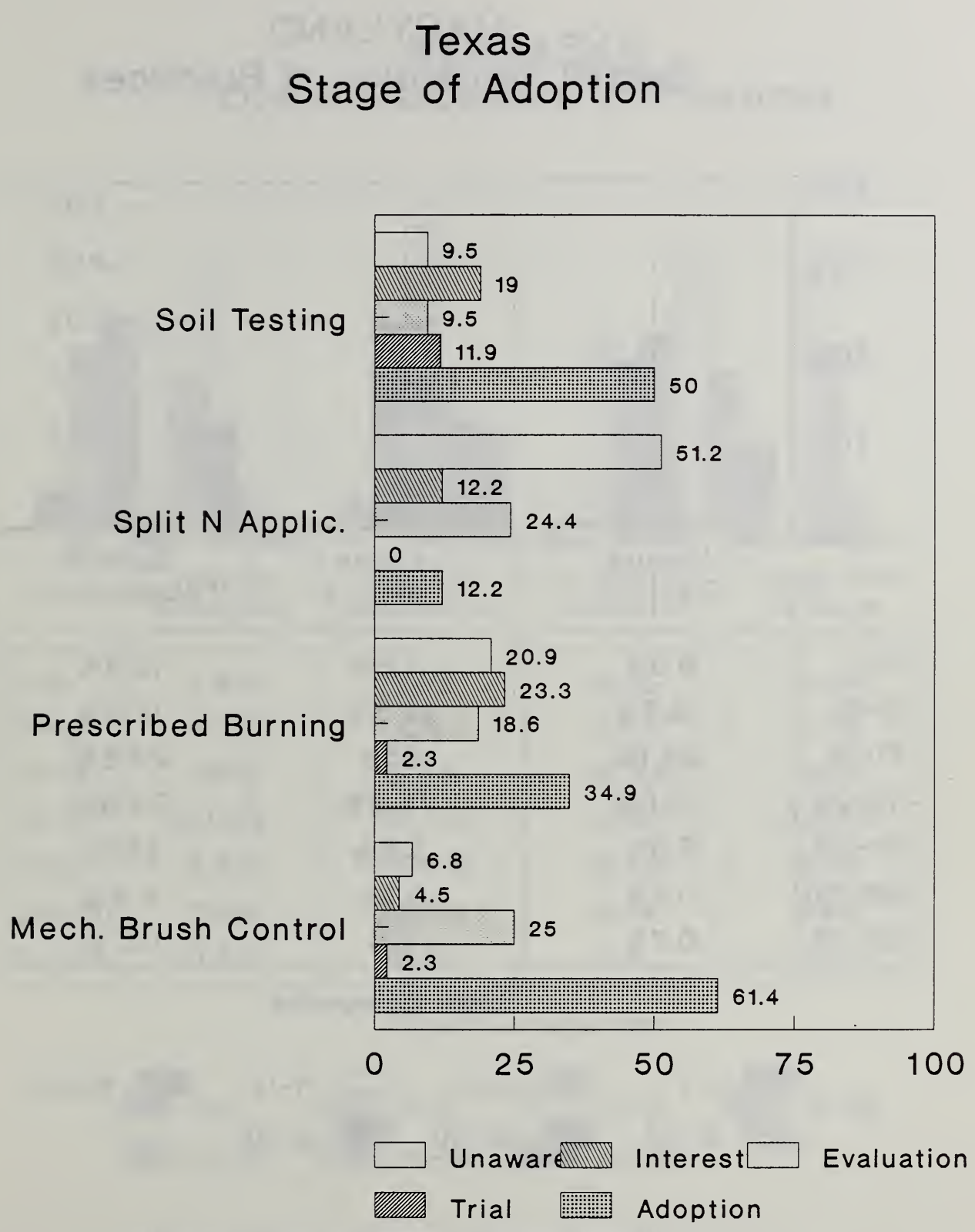
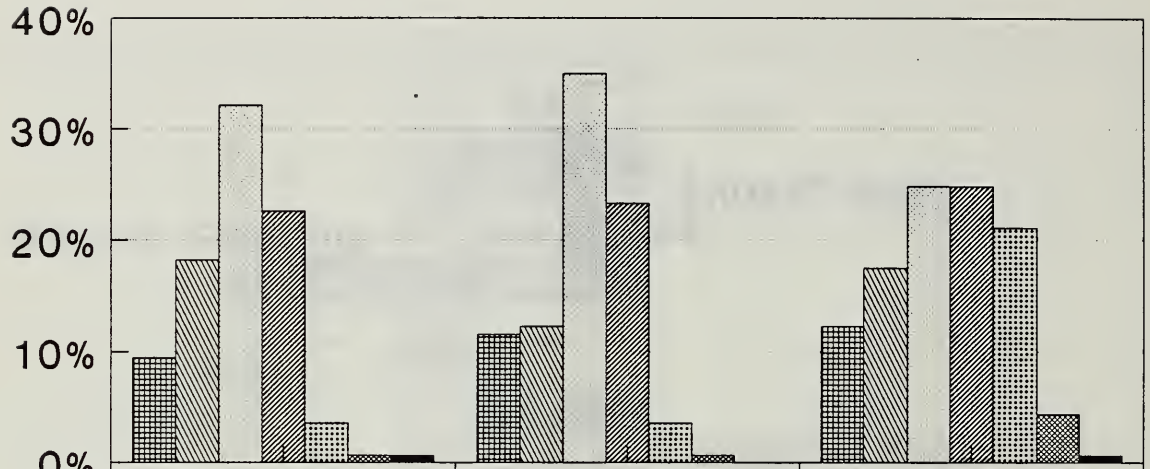

Texas
Stage of Adoption
Soil Testing
9.5
19
9.5
11.9
50
Split N Applic.
51.2
12.2
24.4
0
12.2
Prescribed Burning
20.9
23.3
18.6
2.3
34.9
Mech. Brush Control
6.8
4.5
25
2.3
61.4
0
25
50
75
100
Unaware
Interest
Evaluation
Trial
Adoption

Figure 22.

MARYLAND
Overall Perception of Practices



	Manure Crediting	Legume Crediting	Split N Application
1-5	9.5%	11.6%	12.3%
6-10	18.2%	12.3%	17.5%
11-15	32.1%	35%	24.8%
16-20	22.6%	23.3%	24.8%
21-25	3.6%	3.6%	21.1%
26-30	0.7%	0.7%	4.4%
31-35	0.7%	0%	0.7%

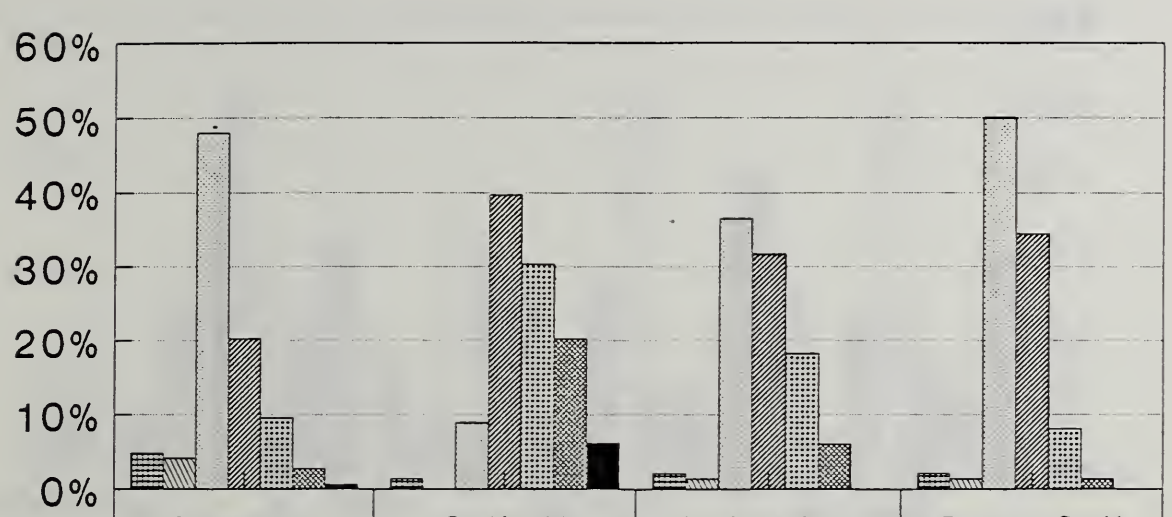
Scale Categories

1-5 6-10 11-15 16-20
21-25 26-30 31-35

Higher values represent more positive perceptions. Totals equal less than 100 percent due to those with no perception

Figure 23.

NEBRASKA
Overall Perception of Practices



	Legume Crediting	Split N Application	Irrigation Schedule	Deep Soil N Tests
1-5	4.8%	1.4%	2.1%	2.1%
6-10	4.1%	0%	1.4%	1.4%
11-15	48%	8.9%	36.5%	50%
16-20	20.3%	39.7%	31.8%	34.5%
21-25	9.5%	30.4%	18.3%	8.1%
26-30	2.8%	20.3%	6.1%	1.4%
31-35	0.7%	6.2%	0%	0%

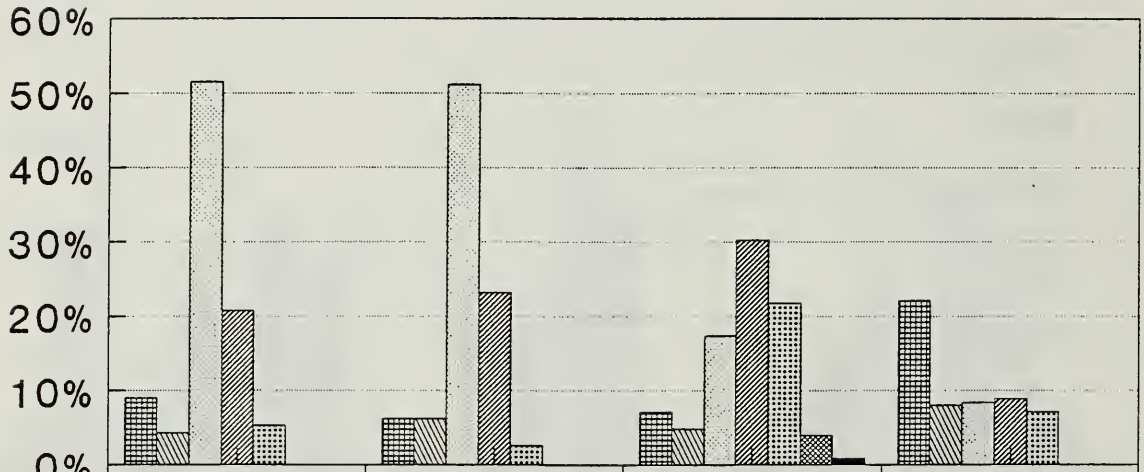
Scale Categories

1-5 6-10 11-15 16-20
21-25 26-30 31-35

Hgher values represent more positive perceptions. Totals equal less than 100 percent due to those with no perception.

Figure 24.

WISCONSIN
Overall Perception of Practices



	Manure Crediting	Legume Crediting	Split N Application	Farmstead Assessment
1-5	9%	6.2%	7.1%	22.1%
6-10	4.3%	6.2%	4.9%	8%
11-15	51.5%	51.1%	17.4%	8.4%
16-20	20.8%	23.2%	30.3%	8.9%
21-25	5.3%	2.6%	21.8%	7.1%
26-30	0%	0%	4%	0%
31-35	0%	0%	0.9%	0%

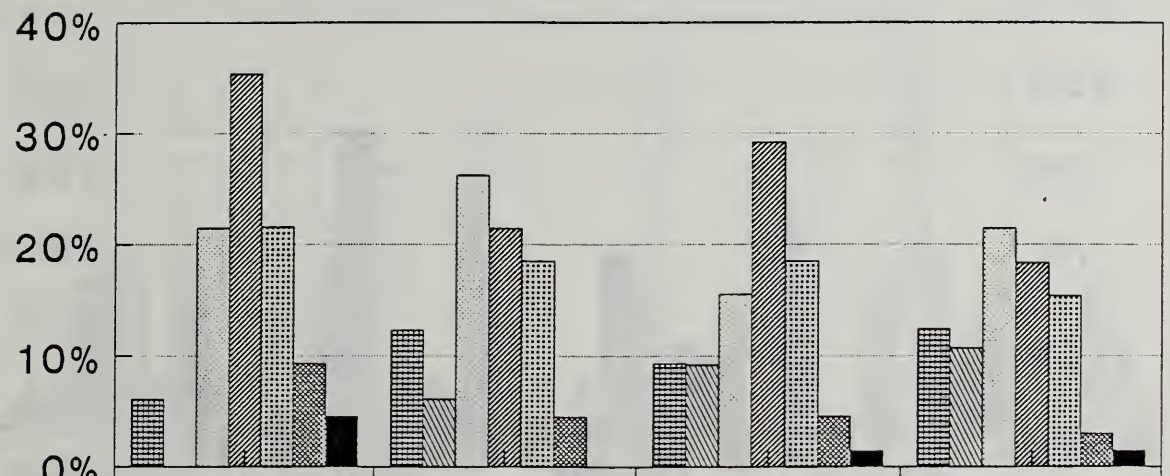
Scale Categories

1-5 6-10 11-15 16-20
21-25 26-30 31-35

Higher values represent more positive perceptions. Totals equal less than 100 percent due to those with no perception

Figure 25.

CALIFORNIA
Overall Perception of Practices



	Tailwater Recirculat	Gravity Tailwater	Static System	Float Valve Rice Box
1-5	6.1%	12.3%	9.3%	12.4%
6-10	0%	6.1%	9.2%	10.7%
11-15	21.5%	26.2%	15.5%	21.5%
16-20	35.4%	21.5%	29.2%	18.4%
21-25	21.6%	18.5%	18.5%	15.4%
26-30	9.3%	4.5%	4.6%	3%
31-35	4.6%	0%	1.5%	1.5%

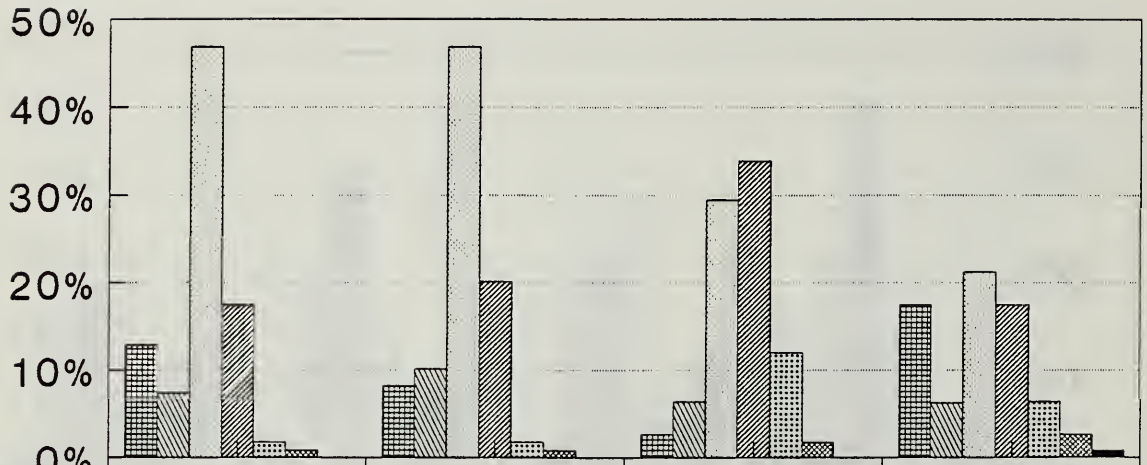
Scale Categories

1-5 6-10 11-15 16-20
21-25 26-30 31-35

Higher values represent more positive perceptions. Totals equal less than 100 percent due to those with no perception

Figure 26.

MINNESOTA
Overall Perception of Practices



	Manure Crediting	Legume Crediting	Split N Application	Irrigation Schedule
1-5	12.9%	8.2%	2.7%	17.5%
6-10	7.4%	10.1%	6.4%	6.3%
11-15	46.8%	46.8%	29.4%	21.2%
16-20	17.5%	20.2%	33.9%	17.5%
21-25	1.8%	1.8%	12%	6.4%
26-30	0.9%	0.9%	1.8%	2.7%
31-35	0%	0%	0%	0.9%

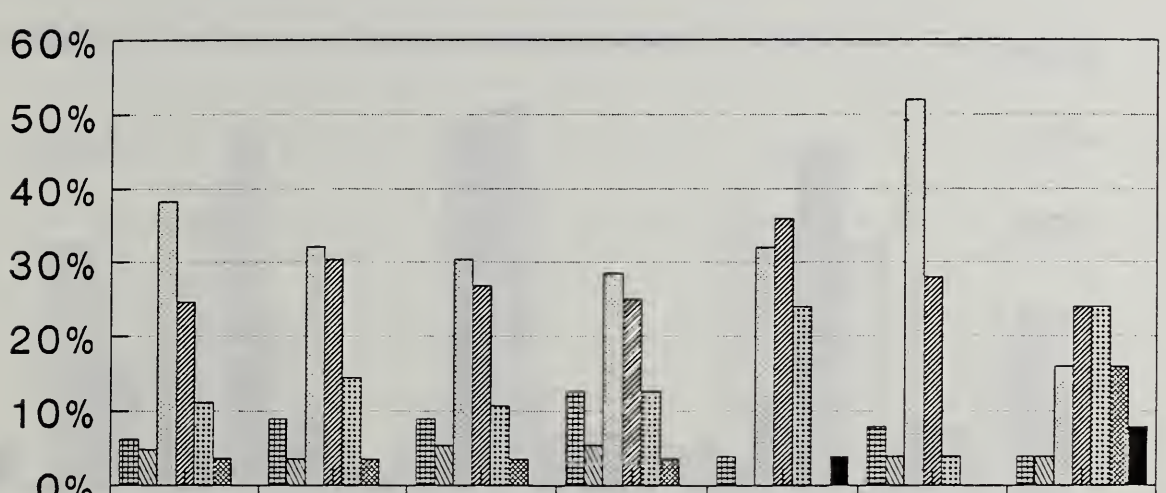
Scale Categories

1-5 6-10 11-15 16-20
21-25 26-30 31-35

Hgher values represent more positive perceptions. Totals equal less than 100 percent due to those with no perception.

Figure 27.

FLORDIA
Overall Perception of Practices



	Irrig Sched	Mult N Applic	Irrig Tests	Soil Moist Test	Fert Mgmt	H2O Table Monitor	Seep Irrig
1-5	6.2%	9%	9%	12.6%	4%	8%	4%
6-10	4.9%	3.6%	5.4%	5.4%	0%	4%	4%
11-15	38.2%	32.1%	30.4%	28.5%	32%	52%	16%
16-20	24.7%	30.4%	26.8%	25%	36%	28%	24%
21-25	11.2%	14.4%	10.7%	12.6%	24%	4%	24%
26-30	3.7%	3.6%	3.6%	3.6%	0%	0%	16%
31-35	0%	0%	0%	0%	4%	0%	8%

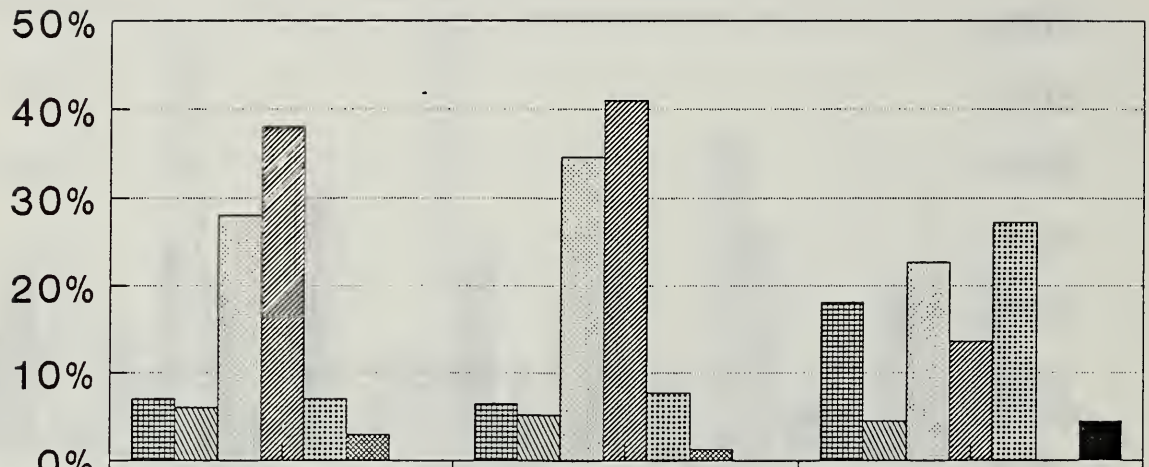
Scale Categories

1-5 6-10 11-15 16-20
21-25 26-30 31-35

Higher values represent more positive perceptions. Totals equal less than 100 percent due to those with no perception.

Figure 28.

NORTH CAROLINA
Overall Perception of Practices



	Manure Crediting	Split N Application	Poultry Composting
1-5	7%	6.5%	18.1%
6-10	6%	5.2%	4.5%
11-15	28%	34.6%	22.7%
16-20	38%	41%	13.6%
21-25	7%	7.7%	27.2%
26-30	3%	1.3%	0%
31-35	0%	0%	4.5%

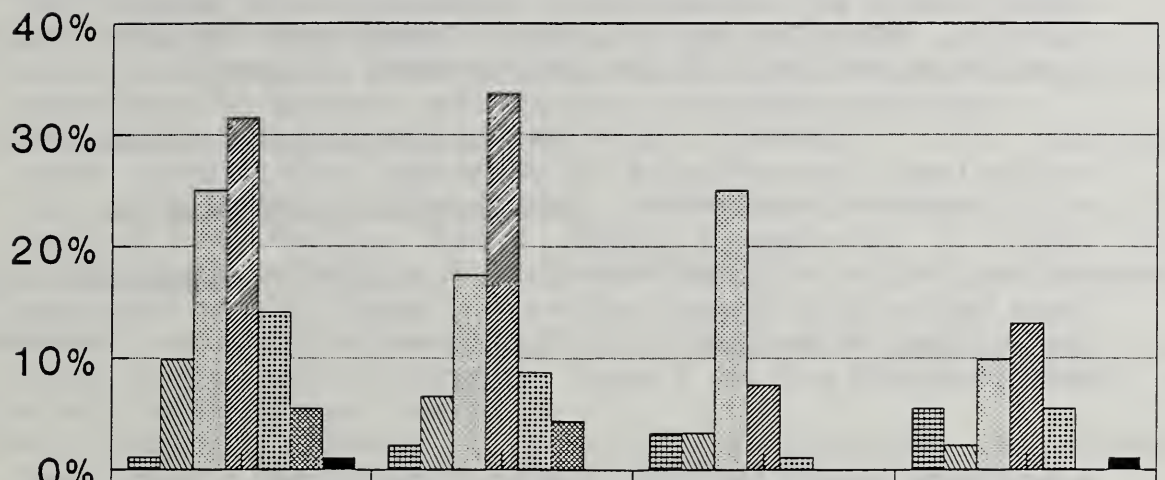
Scale Categories

1-5 6-10 11-15 16-20
21-25 26-30 31-35

Hgher values represent more positive perceptions. Totals equal less than 100 percent due to those with no perception.

Figure 29.

TEXAS
Overall Perception of Practices



	Presc. Burn	Mech Brush	Soil Test	Split N Applic
1-5	1.1%	2.2%	3.3%	5.5%
6-10	9.9%	6.6%	3.3%	2.2%
11-15	25%	17.4%	25%	9.9%
16-20	31.5%	33.7%	7.6%	13.1%
21-25	14.1%	8.7%	1.1%	5.5%
26-30	5.5%	4.4%	0%	0%
31-35	1.1%	0%	0%	1.1%

Scale Categories

1-5 6-10 11-15 16-20
21-25 26-30 31-35

Higher values represent more positive perceptions. Totals equal less than 100 percent due to those with no perception.

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